

Adams Lake Aquatic Vegetation Management Plan

LaGrange County, Indiana

2007 – 2011



Prepared for:

The Adams Lake Conservation Club

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Executive Summary

The following report outlines a long-term aquatic plant management strategy for Adams Lake. Aquatic Weed Control was contracted by the Adams Lake Conservation Club to conduct aquatic vegetation surveys and propose a vegetation management plan based on the results of these surveys. Funding for this plan was provided by the Adams Lake Conservation Club and the Indiana Department of Natural Resources (IDNR) through the Lake and River Enhancement (LARE) program.

In 2007, Aquatic Weed Control conducted two aquatic vegetation surveys to characterize the plant community of Adams Lake. An early season quantitative survey (Tier II) was conducted on June 8, 2007 and a late season Tier II survey was conducted on July 27, 2007. Each survey followed protocol established by the IDNR to evaluate the health of aquatic plant community. Based on the results of the June 8, survey, approximately 8 acres of Adams Lake were treated with 2, 4-D for the control of Eurasian watermilfoil (EWM) on July 11, 2007.

Based on the results of vegetation surveys, as well as interaction with association members, lake users, and IDNR biologists, a management plan was constructed to help reach the three major management goals established by the IDNR for all Indiana public lakes, including those applying for LARE funding. These three goals are listed below.

1. Develop or maintain a stable, diverse aquatic plant community that supports a good balance of predator and prey fish and wildlife species, good water quality and is resistant to minor habitat disturbances and invasive species.
2. Direct efforts to preventing and/or controlling the negative impacts of aquatic invasive species.
3. Provide reasonable public recreational access while minimizing the negative impacts on plant and wildlife resources.

The late season 2007 vegetation survey of Adams Lake found a plant community with above average species diversity when compared to area lakes (0.83). Thirteen different plant species were collected in Adams Lake in July of 2007. Two invasive plant species, Eurasian watermilfoil (*Myriophyllum spicatum*), and curly leaf pondweed (*Potamogeton crispus*) were present in Adams Lake in spring of 2007. Eurasian watermilfoil was not found in Adams Lake in the late season survey after the 2, 4-D treatment had taken place. Eurasian watermilfoil is of special concern in Adams Lake although it was only collected in the area around the public access in the east end of the lake. This plant species provides poor fish habitat, crowds out beneficial native plant species, and can impair recreation when present in great abundance.

Funding may be awarded by the LARE program again in 2008 to chemically treat areas of Eurasian watermilfoil infestation. Chemical treatment options for selective, root control of Eurasian watermilfoil include the following herbicides: Sonar (active ingredient: fluridone), Renovate (active ingredient: triclopyr), and 2, 4-D. Sonar treatments provide the most complete control of Eurasian watermilfoil and can also provide multiple years of control. Renovate and 2, 4-D, while very effective, are normally applied to the same areas on a yearly basis to provide control.

Aquatic Weed Control does not recommend the use of Sonar to treat Eurasian watermilfoil in Adams Lake at this time. Sonar will provide effective control of the Eurasian watermilfoil, but the entire lake volume must be treated, as the herbicide is extremely mobile. Since Eurasian watermilfoil is present in only a small portion of Adams Lake, a Sonar treatment would not be cost effective.

The 2008 treatment plan will use 2, 4-D to provide control of Eurasian watermilfoil in areas of infestation. Exact treatment areas will depend upon results of a spring 2008 visual survey. A treatment map will be submitted to the IDNR, and should funding be available, up to 90% of treatment costs may be covered by the LARE program.

It is important to note that Eurasian watermilfoil will be the only plant species specifically targeted in this project, as LARE funds will only be awarded for the control of invasive plant species. The goal is not to eliminate vegetation in Adams Lake, but to improve the health of the plant community. Native vegetation will still be abundant in shallow areas after treatment, and control of these natives must be privately funded. The goal will be to reduce the Eurasian watermilfoil population and allow for the recovery of native plant species that will provide better fish habitat, foster good water quality and pose less interference to recreational use of the lake.

Cost estimates for 2008 are included below. These figures are estimates only and are subject to change pending 2008 chemical pricing.

Project	Total Cost	LARE Share	Association Share
Treat up to 13 acres in Adams Lake with 2, 4-D for Eurasian watermilfoil	Up to \$4,875	Up to \$4,387.50	Up to \$487.50
2008 Plant Surveys and Plan update	Up to \$4,000	Up to \$3,600	Up to \$400
Totals	Up to \$8,875	Up to 7,987.50	\$887.50

Acknowledgements

Aquatic vegetation surveys conducted on Adams Lake were made possible by funding from the Adams Lake Conservation Club and the Indiana Department of Natural Resources through the Lake and River Enhancement Program. Aquatic Weed Control would like to extend special thanks to Indiana Department of Natural Resources (IDNR) District 3 biologist Jed Pearson for providing procedural training for Tier II aquatic vegetation surveys. District 2 Fisheries Biologist Neil Ledet provided valuable information for this management plan. Gwen White and Angela Sturdevant, aquatic biologists for the IDNR Division of Fish and Wildlife provided valuable consultation regarding the requirements and objectives of this lake management plan. Brad Fink, and Jason Doll provided assistance and training for data analysis computer programs. Aquatic Weed Control would also like to thank the members of the Adams Lake Conservation Club for their commitment to improving this lake and for valuable discussion and input brought forward at the informational meeting held on August 25, 2007.

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1.0 Introduction

Aquatic Weed Control was contracted by the Adams Lake Conservation Club to develop a long-term aquatic vegetation management plan. Funding for this report was provided by the Adams Lake Conservation Club and the Department of Natural Resources through the Lake and River Enhancement (LARE) program.

When a person registers a boat within the state of Indiana a lake enhancement fee is included in the cost of registry. Two thirds of the total proceeds collected from this fee are then used to fund projects designed to improve the quality of Indiana lakes. One third of the total proceeds is set aside for invasive plant control, while one third is set aside for sediment removal and construction projects that benefit Indiana lakes.

The aquatic vegetation surveys included in this report, as well as the management plan, are required by the state to receive funding for the treatment of exotic aquatic vegetation. Should a lake be selected for LARE funding, up to 100,000 dollars can be awarded for a whole lake treatment. Following a whole lake treatment up to 20,000 dollars per year can be awarded for up to 3 years for the maintenance of aquatic invasive plant species. If the whole lake is not treated, up to 20,000 dollars can be available annually for up to three years. Requests for funding are reviewed by the LARE office and funds will be distributed at the discretion of the director of the DNR.

The Adams Lake Conservation Club has contracted with Aquatic Weed Control for LARE activities starting in 2007. Prior to this time, no aquatic vegetation management plan had been fully developed. The first LARE funded aquatic vegetation survey conducted by Aquatic Weed Control took place on June 8, 2007. Based on the results of this survey Eurasian watermilfoil was very prevalent in the areas surrounding the public access site. This area was targeted for herbicide treatments to reduce the Eurasian watermilfoil population. The following chart summarizes all 2007 LARE funded activities on Adams Lake.

Table 1: Adams Lake LARE History

Year	Action	Date	Funding Source
2007	Spring and Late Season Aquatic Vegetation Surveys as well 2, 4-D application and Management Plan Update	Spring Survey June 8, 2007 2, 4-D Application ~8 acres. July 11, 2007 Late Season Survey July 27, 2007	Lake and River Enhancement Adams Lake Conservation Club

2.0 Watershed and Lake Characteristics

Adams Lake is located in LaGrange County Indiana, near the town of Wolcottville. Adams Lake is 308 acres with a maximum depth of 93 feet and an average depth of 25 feet. Approximately 95% of the shoreline of Adams Lake is developed, with the only major undeveloped portion being in the southwest corner of the lake near the outlet.

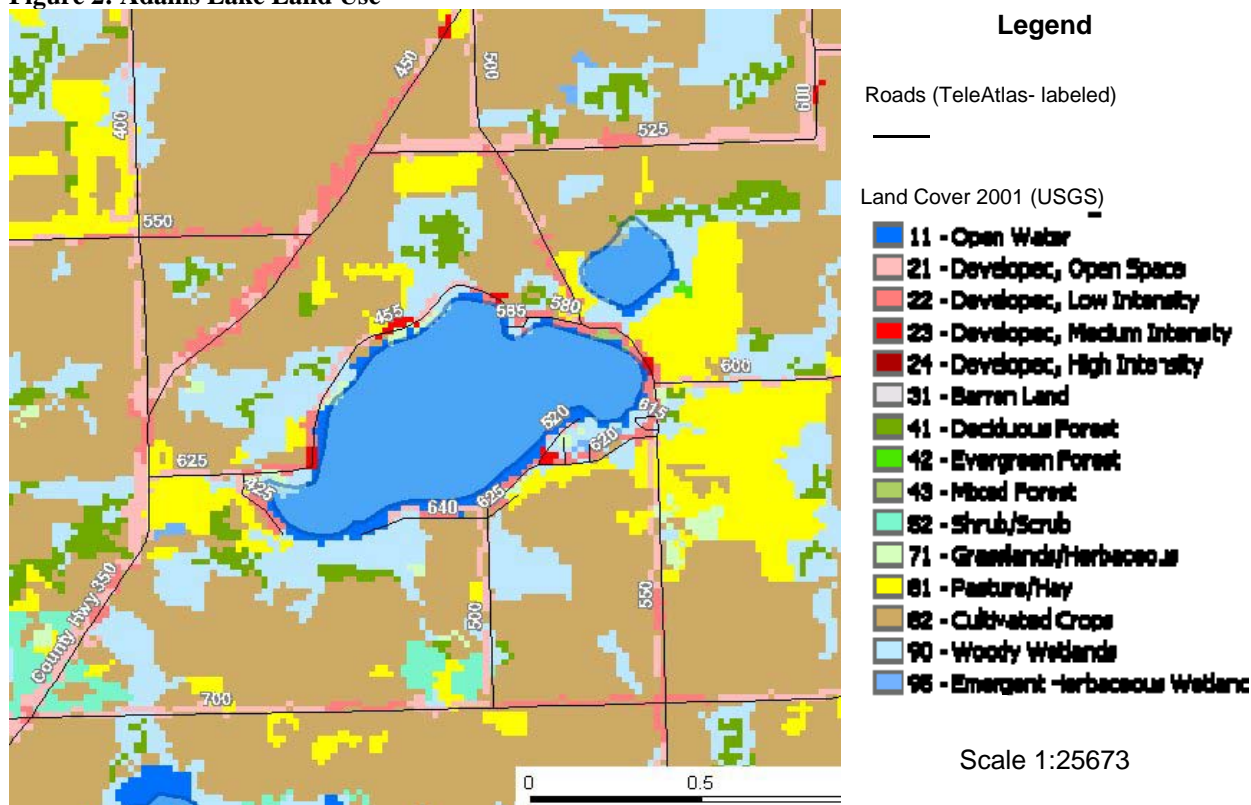
The major inlet to Adams Lake is adjacent to the public access site at the east end of the lake, just off of county road 550 East. This inlet runs from Blackman Lake, and enters Adams Lake through the small channel by the access. This inlet may contribute to the muck/silt bottom found in this corner of the lake, in contrast to the rest of the lake, which has a marl/sand bottom.

The outlet to Adams Lake is located in its southwest corner. A concrete wall dam has been constructed in this outlet as well. The spillway is not adjustable, so the water level cannot be raised or lowered with this structure. Emergent vegetation is abundant in the outlet and can restrict water flow. Figure 1 identifies the inlet and outlet to Adams Lake.

Figure 1: Adams Lake Inlet and Outlet



Major land use in the Adams Lake watershed is for agricultural purposes with the majority of that land being used for row crops. Pasture lands and wetlands are also common in the Adams lake Watershed. Figure 2 shows land uses around Adams Lake.

Figure 2: Adams Lake Land Use

This map was prepared by the Indiana Geological Survey, using data believed to be accurate; however, a margin of error is inherent in all maps. This product is distributed "AS-IS" without warranties of any kind, either expressed or implied, including but not limited to warranties of suitability of a particular purpose or use. There is no attempt in either design or production of this map to define the limits or jurisdiction of any federal, state or local government. A detailed on-the-ground survey and historical analysis of a single site may differ from this map.

Indiana Geological Survey

Dissolved Oxygen

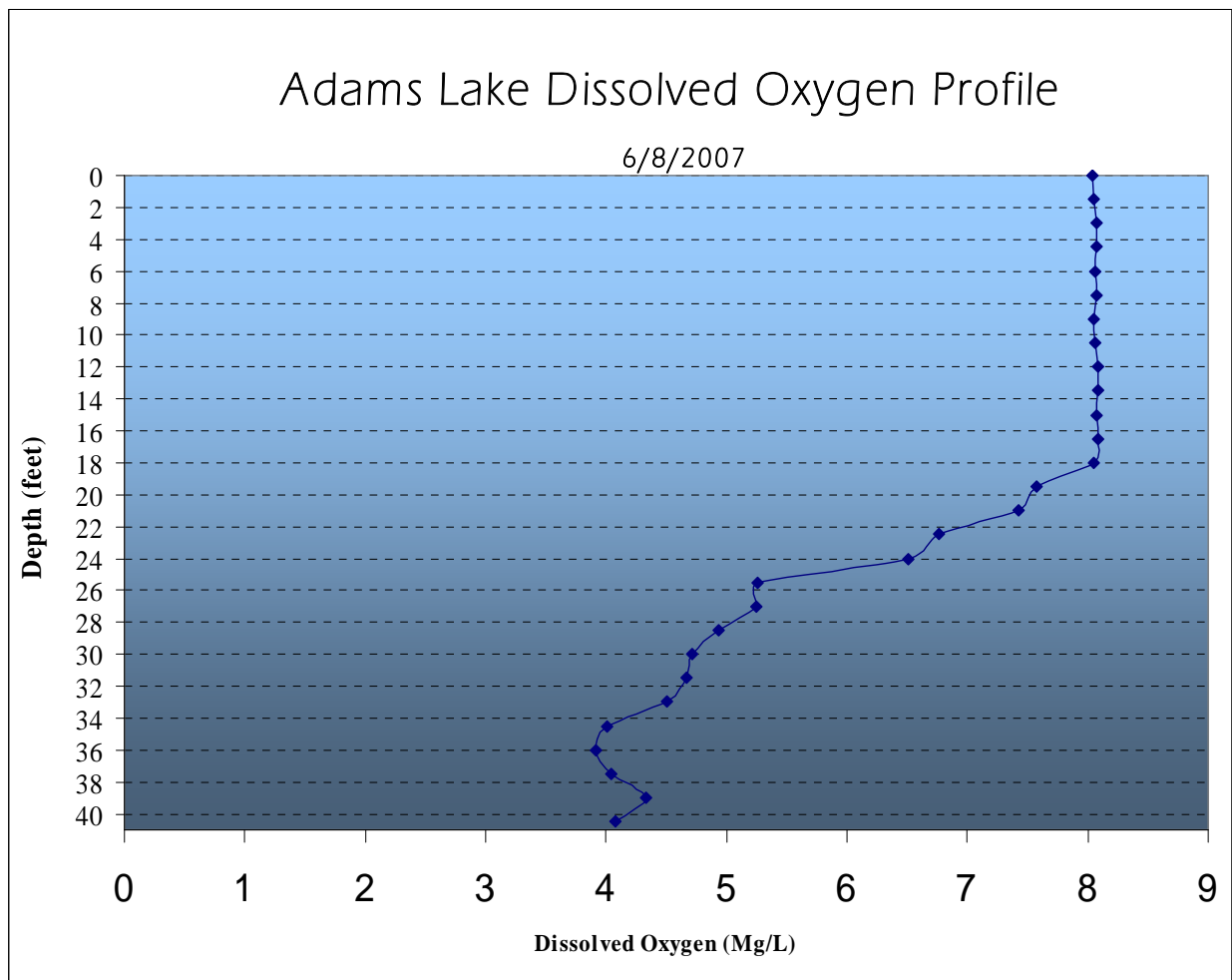
Secchi disk readings were taken in both surveys by Aquatic Weed Control in 2007. Secchi depth was measured at 8.5 feet in June and at 8.1 feet in late July. Based on these measurements, water clarity is very good when compared with many other area lakes.

On June 8, 2007 and July 27, 2007 Aquatic Weed Control measured dissolved oxygen and temperature throughout the water column in Adams Lake. This data was used to construct dissolved oxygen and temperature profiles.

Dissolved oxygen requirements to maintain healthy fish populations of warm-water species are at least 2-5 mg of oxygen per liter of water, while cold-water fish species require 5-9 mg of oxygen per liter of water (Kalff, 2002, p237).

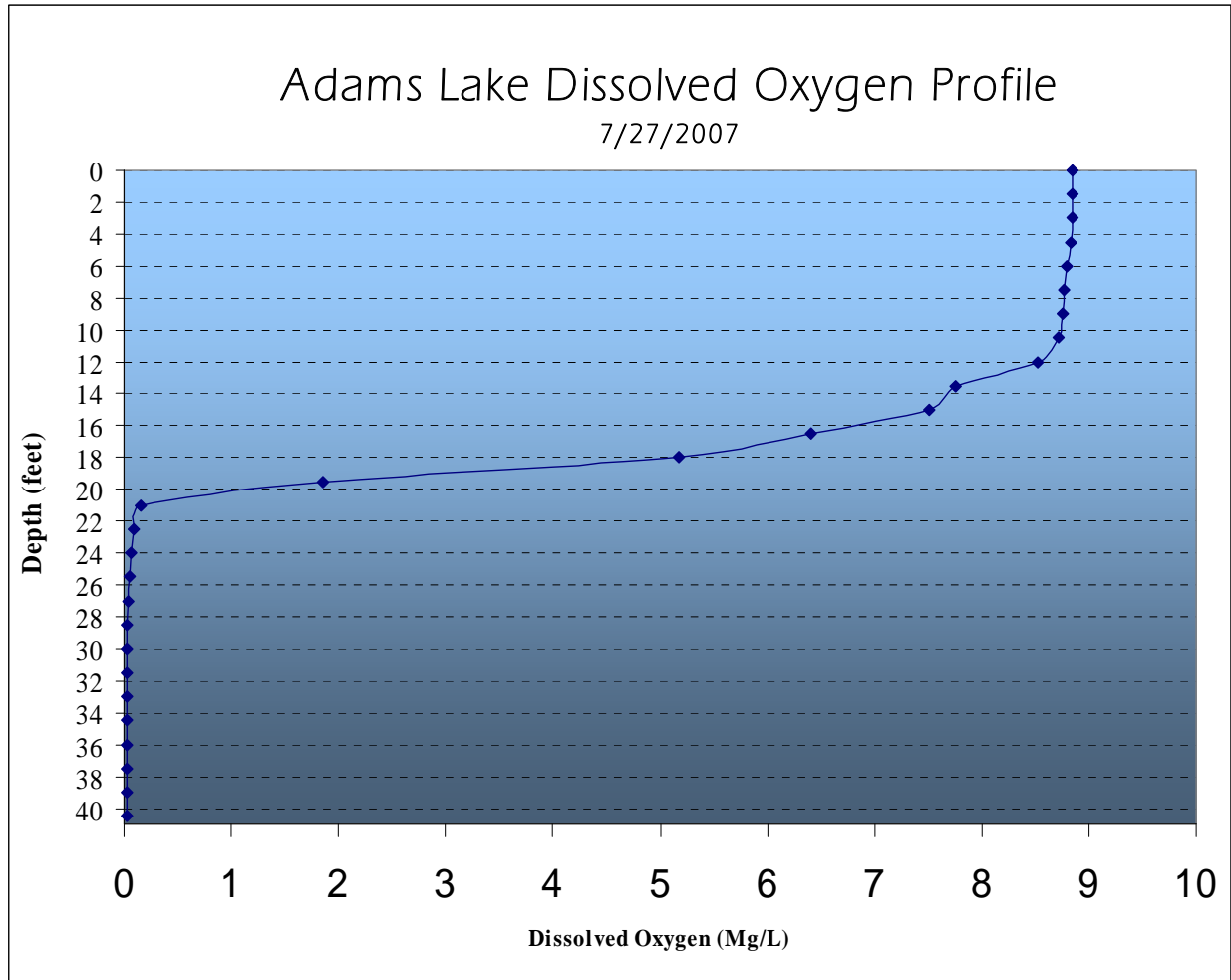
In June, very little stratification had taken place in Adams Lake. Oxygen levels remained constant down to a depth of 18 feet. Even at depths of 40 feet, oxygen readings were still at 4 mg/L. Figure 3 shows the June dissolved oxygen profile.

Figure 3: Adams Lake June 2007 Dissolved Oxygen Profile



On July 27, Adams Lake showed much stronger stratification. Dissolved Oxygen remained stable down to 11 feet and then began to decline rapidly. At 20 feet, dissolved oxygen was below 1mg/L. When compared with other area lakes, these oxygen readings were high, with adequate oxygen to sustain fish life down to at least 18 feet (Figure 4).

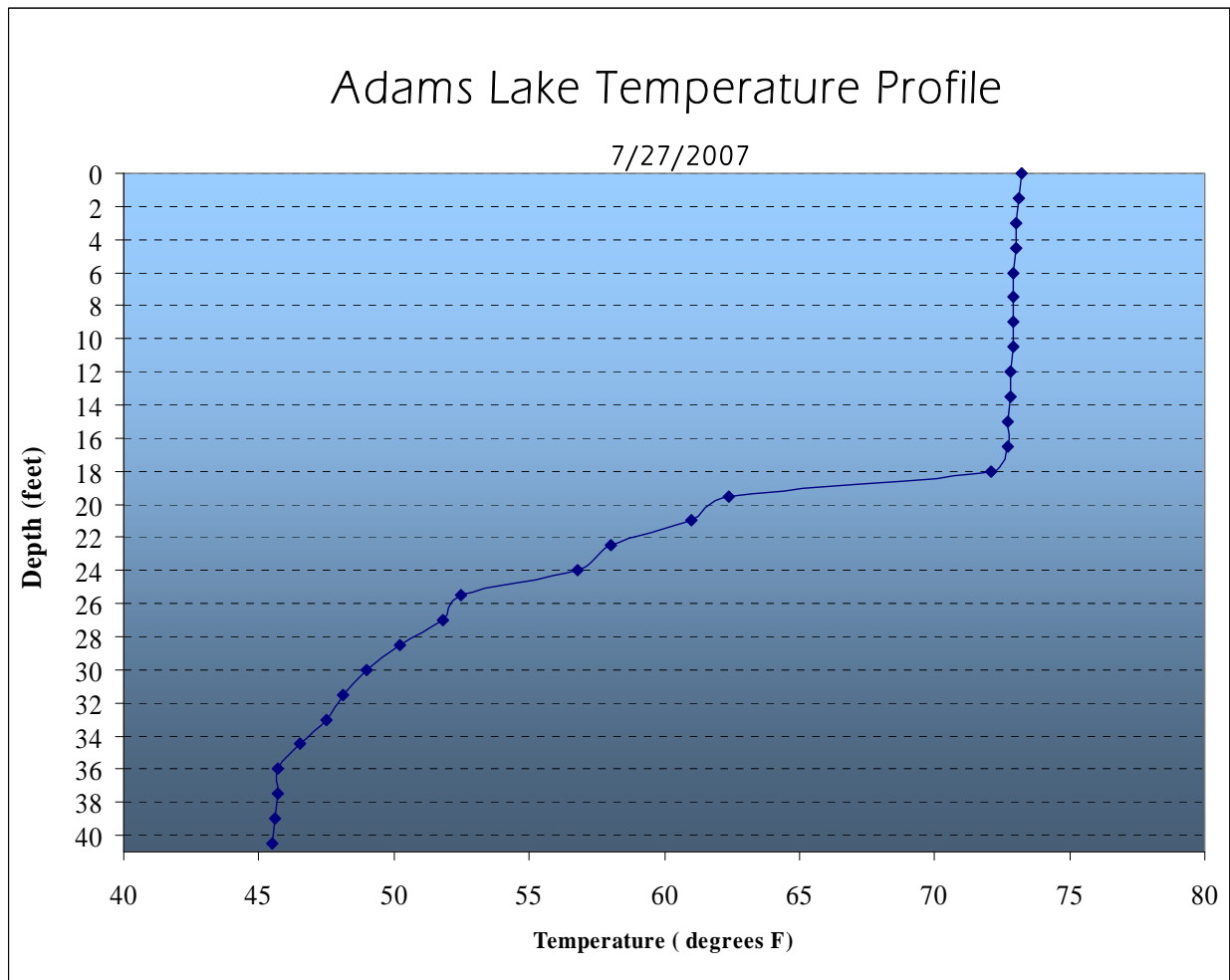
Figure 4: Adams Lake July 2007 Dissolved Oxygen Profile



The metalimnion is the transition zone between the surface water and the deep water. It is usually accompanied by rapid changes in dissolved oxygen and temperature. The metalimnion in Adams Lake was between 12 and 26 feet, characterized by a loss of dissolved oxygen and a decrease in temperature.

The thermocline is a rapid temperature change associated with the transition from surface water to deep water. In Adams Lake water temperature remains stable from the surface down to 18 feet. Temperature then drops rapidly with depth. This indicates a thermocline at around 18 feet (Figure 5).

Figure 5: Adams Lake July 2007 Temperature Profile.



3.0 Lake Uses

Adams Lake receives very high levels of public use during the summer months. The shoreline is largely developed and many lake residents use the lake on a regular basis. A DNR public access site is located on the east shore on county road 550 East. This access site has limited parking (7-9 vehicles) but also adds to the number of boats using the lake (Figure 6).

Figure 6: Adams Lake IDNR Public Access Site



Boating and water skiing are very popular activities on Adams Lake, especially among lake residents. The Adams Lake Conservation Club has adopted voluntary high speed boating hours between 10:00 am and 6:00 pm. Before 10:00 am and after 6:00 pm there is a 10 mile per hour speed limit (Figure 7).

Figure 7: Adams Lake Boating Rules



Fishing is another popular activity on Adams Lake, both in summer and through the ice. Popular sportfish include largemouth bass, bluegills, black crappies and yellow perch. Walleye and Tiger Muskellunge were once stocked by the IDNR in 1990 but have been discontinued. Private low density stockings of walleye have also been permitted by the IDNR.

4.0 Fisheries

District 2 Fisheries Biologist Neil Ledet provided the most recent fisheries survey information for Adams Lake. This fisheries survey was conducted in June of 2005. Table 2 summarizes data for each fish species collected during the survey. Yellow perch were the most frequently collected species in the survey, followed by largemouth bass and bluegills.

Table 2: IDNR Fish Species List

SPECIES AND RELATIVE ABUNDANCE OF FISHES COLLECTED BY NUMBER AND WEIGHT					
*COMMON NAME OF FISH	NUMBER	PERCENT	LENGTH RANGE (inches)	WEIGHT (pounds)	PERCENT
Yellow perch	221	38.2	3.8-13.3	79.33	32.1
Largemouth bass	162	28.0	2.4-14.2	96.15	39.0
Bluegill	110	19.0	2.0-10.2	16.96	6.9
Rock bass	32	5.5	1.9-10.3	3.36	1.4
Warmouth	10	1.7	2.6-7.2	1.21	0.5
Yellow bullhead	10	1.7	9.3-14.7	7.36	3.0
Black crappie	6	1.0	3.4-14.0	4.11	1.7
Walleye	5	0.9	6.9-25.6	11.08	4.5
Brown bullhead	4	0.7	13.1-13.7	4.08	1.7
Golden shiner	3	0.5	2.8-3.6	0.03	**
Longnose gar	3	0.5	25.5-36.0	7.44	3.0
Bowfin	2	0.3	21.1-21.3	6.35	2.6
Carp	2	0.3	11.8-21.4	5.26	2.1
Grass pickerel	2	0.3	7.6-9.5	0.26	0.1
Pumpkinseed	2	0.3	5.9-6.0	0.27	0.1
Central mud minnow	1	0.2	2.7	0.03	**
Lake chubsucker	1	0.2	8.4	0.28	0.1
Mimic shiner	1	0.2	2.1	0.01	**
Redear	1	0.2	6.4	0.18	0.1
Spotted gar	1	0.2	28.4	3.09	1.3
Brook silverside	abundant				

Table 3 was also part of the June 2005 fisheries survey. It shows the length of 4 commonly species at different ages.

Table 3: Adams Lake Back Calculated Length at Each Age

Species Yellow perch	YEAR CLASS	NUMBER OF FISH AGED	SIZE RANGE	BACK CALCULATED LENGTH (inches) AT EACH AGE							
				I	II	III	IV	V	VI	VII	VIII
Intercept = 1.2	2004	1*	3.8	3.0							
	2003	21	6.1 - 8.3	2.9	6.3						
	2002	10	7.5 - 9.4	2.8	5.5	8.2					
	2001	8	9.5 - 10.6	2.8	5.2	8.1	9.6				
	2000	16	9.9 - 12.3	2.9	5.6	8.5	9.9	10.8			
	1999	6	10.7 - 12.7	3.3	6.1	9.0	10.4	11.2	11.8		
	1998	3	12.8 - 13.3	3.4	5.0	7.9	10.3	11.5	12.3	12.8	
	AVERAGE LENGTH			3.0	5.6	8.3	10.1	11.2	12.0	12.8	
	NUMBER AGED			65	64	43	33	25	9	3	

Species Largemouth bass	YEAR CLASS	NUMBER OF FISH AGED	SIZE RANGE	BACK CALCULATED LENGTH (inches) AT EACH AGE							
				I	II	III	IV	V	VI	VII	VIII
Intercept = 0.8	2004	3	4.3 - 4.6	3.9							
	2003	1*	8.3	4.9	6.7						
	2002	53	8.0 - 11.8	4.3	6.9	9.3					
	2001	21	10.4 - 12.9	3.5	6.8	9.4	11.3				
	2000	13	12.1 - 13.7	3.6	6.7	9.3	11.2	12.6			
	AVERAGE LENGTH			3.8	6.8	9.4	11.3	12.6			
	NUMBER AGED			90	88	87	34	13			

Species Bluegill	YEAR CLASS	NUMBER OF FISH AGED	SIZE RANGE	BACK CALCULATED LENGTH (inches) AT EACH AGE							
				I	II	III	IV	V	VI	VII	VIII
Intercept = 0.8											
	2003	8	2.8 - 4.8	1.4	3.0						
	2002	17	3.8 - 7.5	1.4	2.6	4.8					
	2001	3	7.6 - 7.9	1.2	2.6	4.8	7.4				
	2000	3	8.2 - 9.0	1.5	3.0	5.2	7.6	8.4			
	1999	2*	9.6 - 9.8	2.0	4.0	6.5	8.2	9.1	9.5		
	1998	4	9.4 - 9.9	1.9	3.4	5.5	7.5	8.6	9.1	9.5	

1997	2*	10.0 - 10.1	1.6	3.0	4.9	6.5	8.1	9.0	9.5	9.9
AVERAGE LENGTH			1.5	2.9	5.1	7.5	8.5	9.1	9.5	
NUMBER AGED			39	39	31	14	11	8	6	2

Species Rock bass	YEAR CLASS	NUMBER OF FISH AGED	SIZE RANGE	BACK CALCULATED LENGTH (inches) AT EACH AGE							
				I	II	III	IV	V	VI	VII	VIII
Intercept = 1.0	2004	5	1.9 - 2.5	2.0							
	2003	3	3.9 - 5.0	1.9	3.9						
	2002	3	5.7 - 6.4	2.0	3.6	5.5					
	2001	4	6.8 - 8.3	1.8	3.6	5.6	7.4				
AVERAGE LENGTH				1.9	3.7	5.5	7.4				
NUMBER AGED				15	10	7	4				

The following is an excerpt from the IDNR fish management report on Adams Lake conducted in 2005 by Neil Ledet and Larry Koza. This is an excerpt from the discussion section and not the entire report. It summarizes the fish community at Adams Lake. Aquatic Weed Control would like to thank District 2 Fisheries Biologist Neil Ledet and Assistant Fisheries Biologist Larry Koza for providing this information.

“Adams Lake continues to support a good sport fish population dominated by yellow perch, largemouth bass and bluegill. Age-3 and older bluegill together with all ages of yellow perch grew at an above average rate for northern Indiana natural lakes. This was reflected in the number of larger fish of these species present in the sample. The percentages of 10.0-in TL and larger perch and 12.0-in TL and larger perch, in particular, were very good for Indiana natural lakes. Largemouth bass abundance at Adams Lake is low compared to similar size natural lakes but appears to be increasing. Although only one legal size fish was collected, bass numbers are still sufficient to provide bass fishing opportunities.

Additional species present included walleye, black crappie and redear. The walleye numbers are small but these fish do provide a bonus fishery. Black crappies in Adams Lake historically have not contributed significantly to the fishery. During the 1992 creel, only 209 crappies were harvested (0.7 per acre) representing 4% of the total fish harvest by number. Occasionally large crappie are taken, however, as evidenced by the 14.0-in TL specimen collected during the survey. In addition to that fish, a 12.6-in TL and a 13.3-in TL crappie were also collected. Redear were stocked by the lake residents in 2004, despite the historic presence of this fish, with the hopes they will prey on the zebra mussels present in the lake helping to control their spread. The past stocking does not appear to have had an impact on redear abundance, which remains low.

Aquatic vegetation abundance at Adams Lake has increased over the years, as it has in many of our natural lakes. The area of the lake impacted the most has been the east shore where the main inlet enters the lake. Typically inlets can carry sediments eroded from farmland into lakes creating fertile beds for the propagation of aquatic plants. This has been the case at Adams Lake. Two species of aquatic plants have caused the most problems over the years, curly-leaf pondweed and Eurasian watermilfoil. The lake association has chemically treated these weeds over the years with varying degrees of

success. During the aquatic plant survey conducted in late August very little of either plant was found throughout Adams Lake. This is not at all atypical for curly-leaf pondweed, as it naturally dies off in lakes in the late summer. The lack of milfoil abundance is curious however. This plant was at low enough levels in 2005 that the residents did not even have to treat it. It is not known at this time why the milfoil failed to appear at nuisance levels this year but this has happened at various other lakes in Northern Indiana in previous years without explanation, a case in point being Crooked Lake in Steuben County. Dead and/or dying milfoil plants from Crooked Lake were even sent to a laboratory for analysis but a satisfactory diagnosis was never obtained. The cause or causes for the mysterious disappearance of the milfoil will require further investigation.

The water quality at Adams Lake is considered good, despite increased eutrophication over the years. No fish diseases or parasites were observed during the survey. Shoreline erosion was minimal.”

5.0 Problem Statement

Eurasian watermilfoil, curly leaf pondweed and brittle naiad are all exotic species found in Adams Lake. Of these three species Eurasian watermilfoil is many times considered a highest priority when considering funding requests because of its aggressive growth and detrimental effects to the plant community.

In lakes where Eurasian milfoil is left unchecked, well-diversified plant communities can be decimated, although in some lakes native plants compete well with Eurasian watermilfoil. Eurasian milfoil has the ability to “overwinter,” giving it a distinct growth advantage over many native plants. The milfoil lies dormant during the winter months instead of dying back completely, as do many natives. As spring arrives, the dormant milfoil plants have a head start on many native plants and reach the surface faster, shading out the natives. Eurasian milfoil grows profusely, provides poor fish habitat, inhibits boat navigation, and causes annoyances and even recreational hazards to skiers, swimmers, and other members of the public wishing to enjoy the lake.

In Adams Lake, Eurasian watermilfoil is found in 8 to 10 acres in the east end by the IDNR public access site. This area is heavily silted, which provides the milfoil with an excellent substrate on which to grow. In other areas of the lake, sand, gravel and marl bottoms have likely helped to prevent the milfoil’s spread.

6.0 Management Goals and Objectives

The following management goals have been established by the IDNR for all Indiana lakes, including those applying for LARE funding. Any management practices implemented on Adams Lake are to directly facilitate the achievement of these three goals:

1. Develop or maintain a stable, diverse aquatic plant community that supports a good balance of predator and prey fish and wildlife species, good water quality and is resistant to minor habitat disturbances and invasive species.
2. Direct efforts to preventing and/or controlling the negative impacts of aquatic invasive species.
3. Provide reasonable public recreational access while minimizing the negative impacts on plant and wildlife resources.

Specific Objectives:

Specific objectives are needed to ensure that the fundamental goals of the LARE program are met. The following steps are recommended to help achieve LARE management goals for Adams Lake.

1. **Areas infested with Eurasian watermilfoil will be treated with 2, 4-D herbicide.** Exact treatment areas will depend upon results of a spring 2008 visual survey. Using 2, 4-D will provide selective root control of Eurasian watermilfoil.
2. **Vegetation surveys should be conducted to evaluate the plant community both before and after treatment in 2008.** A visual vegetation survey will be conducted in spring of 2008 to develop a Eurasian watermilfoil treatment map. A Tier II vegetation survey should be conducted after the chemical treatment to evaluate the plant community.

7.0 Plant Management History

Private treatments are not common on Adams Lake, with the exception of the area adjacent to the public access site. The sand and gravel bottom that is prevalent in most of the lake is not conducive to abundant plant growth, especially near shore. Chara is common in many of these areas, but seldom grows to nuisance levels.

Past treatments have been common along the shoreline north of the public access site. Private treatments have also taken place at the far west end of the lake in the 2 small channels where the sediment is very silted. Contractors on Adams Lake for private treatments include Weed Patrol, INC. and PineCrest Industries. Aquatic Weed Control conducted the LARE funded Eurasian watermilfoil treatment on July 11, 2007.

A private herbicide treatment for homes adjacent to the public access site overlapped with the LARE funded herbicide treatment in 2007. This area was treated with Reward and Komeen herbicides, which are both contact herbicides. This private treatment took place on June 12, 2007, prior to the LARE treatment on July 11, 2007. Some Eurasian watermilfoil in the LARE treatment area had already been controlled with the contact herbicides from the private treatment. If possible, all private treatments within the LARE treatment area should be delayed until after the Eurasian watermilfoil has been treated using a root control herbicide. The private and LARE funded treatment areas for Adams Lake are outlined in Figure 8.

Figure 8: Adams Lake Treatment Areas



8.0 Aquatic Plant Community Characterization Update

All lake management plans submitted for LARE funding must be accompanied by lake-wide aquatic vegetation surveys. These surveys are used to ensure that the plant community of the entire lake is adequately characterized. They provide information about the overall structure of the plant community, and describe species distribution and abundance in detail.

Two surveys are conducted on each lake in the first year it is involved in the LARE program. One survey is conducted in the spring and another is conducted later in the summer. This two-survey process is essential in providing an accurate representation of all plant species in a lake. Some species such as eel grass (*Vallisneria americana*) are not prevalent until summer and may be under-represented if only one survey was conducted in the spring. Other species such as curly-leaf pondweed (*Potamogeton crispus*) are prevalent in the spring and die off in the summer. This species would be under-represented if only one survey was conducted in the summer. Because of the diverse life cycles of different plants, multiple surveys increase the chance of accurately representing all of the species in a lake.

Tier II survey protocols have been established by the IDNR to ensure that each lake is surveyed in the same manner. These surveys reduce subjectivity and provide a consistent basis for the evaluation of a lake's plant community from year to year, as well as a basis for comparing the plant communities of different lakes. They provide quantifiable results that are vital for monitoring the success of management programs. In short, these vegetation surveys are the foundation for describing an aquatic plant community and proposing an effective management strategy.

8.1 Methods

This section provides an overview of the purpose and procedures behind the Tier II vegetation surveys. The common goal of these surveys is to accurately describe the aquatic plant community of any particular lake. Standard procedures are established to ensure that:

1. The same survey procedures are used for each lake applying for funding.
2. Subjectivity is kept to a minimum to maintain scientific integrity.
3. The sample size for each survey adequately describes the plant community.
4. All data from each lake is recorded and analyzed in the same format.

In short, procedural and analytical consistency makes data from different surveys suitable for comparison and evaluation, while increasing its reliability and overall utility for evaluating the health of a plant community.

The Tier II survey involves using a specially designed rake to collect plants from numerous sites throughout the entire lake. At each site, each species found is recorded, and given an abundance rating based on the amount collected.

8.1.2 Tier II

The purpose of Tier II surveys is to document the distribution and abundance of submersed and floating-leaved aquatic vegetation throughout a lake (IDNR, 2004). A specific number of sample sites are selected based on the amount of surface acreage the lake possessed. Once sample sites are determined, sampling is accomplished using an aquatic vegetation sampling rake constructed according to the guidelines of the 2007 Tier II random sampling procedure manual.

Aquatic vegetation collected at each sample site is sorted according to species, and given a value to represent its abundance at that site. These values are recorded on data sheets distributed by the IDNR. These records are used for data analysis that served to characterize the aquatic vegetation community of a lake.

Random Sampling:

The Tier II survey protocol was updated by the IDNR in 2007. New LARE Tier II protocol requires that sample sites be stratified by depth contour, and that data analysis be provided for each depth contour. Rake scores for plant species are recorded as 1, 3, or 5, as opposed to the original scoring system of 1, 2, 3, 4, or 5.

The number of sample sites needed for a Tier II survey still is based on both lake size and trophic state, as it was in 2006. Trophic state describes the productivity of a lake and is correlated with plant growth, secchi disk, and nutrient availability. There are 4 different trophic states listed by the IDNR: Oligotrophic, Mesotrophic, Eutrophic, and Hypereutrophic. Oligotrophic Lakes usually have clear water and few nutrients, while Hypereutrophic lakes usually have deeply stained water and are nutrient rich. Table 4 is taken from the IDNR 2006 Tier II protocol and shows the maximum depth that must be sampled for a lake in each trophic state. In oligotrophic lakes, where water is clear, plants may be able to grow in up to 25 feet of water because sunlight may still reach the lake bottom in deep water. In hypereutrophic lakes where water is turbid, lack of sunlight will prevent plants from growing in deep water, so the maximum sampling depth is only 10 feet.

Table 4: Sample Depth by Trophic State

Trophic State	Maximum Depth of Sampling (ft)
Hypereutrophic	10
Eutrophic	15
Mesotrophic	20
Oligotrophic	25

Table 5 is used to calculate the number of sample sites need in each depth contour by using lake size and trophic status. The new protocol attempts to more accurately describe the entire littoral zone of a lake and provide more detailed data analysis by separating the littoral zone into 5 foot depth segments.

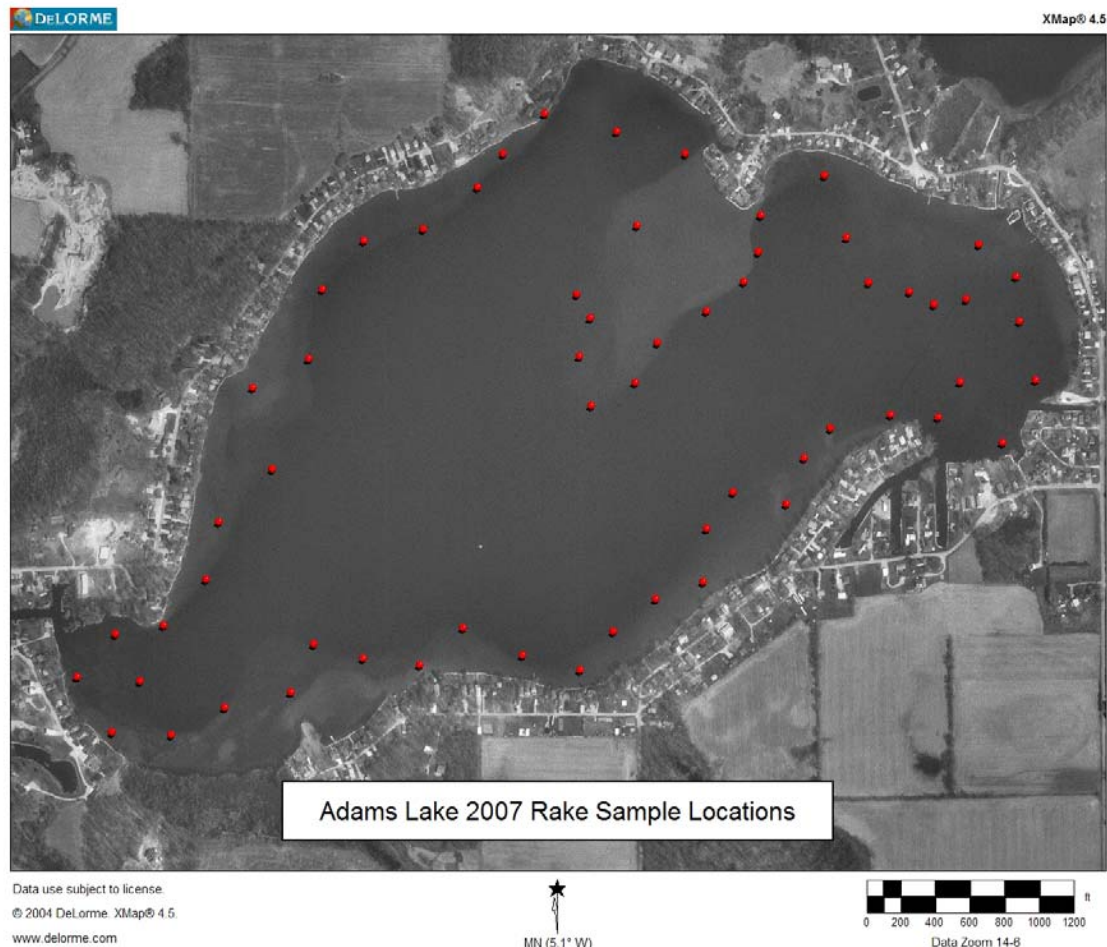
Table 5: Sample Sites by Lake Size and Trophic State

Tier II Sampling															
3															
Table 3. Sample size requirements as determined by lake size, trophic state, and apportioned by depth class.															
Lake Acres	Total # of Sites	Hypereutrophic		Eutrophic			Mesotrophic				Oligotrophic				
		0-5 foot contour	5-10 foot contour	0-5 foot contour	5-10 foot contour	10-15 foot contour	0-5 foot contour	5-10 foot contour	10-15 foot contour	15-20 foot contour	0-5 foot contour	5-10 foot contour	10-15 foot contour	15-20 foot contour	20-25 foot contour
<10	20	10	10	10	7	3	10	5	3	2	10	4	3	2	1
10-49	30	20	10	10	10	10	10	10	7	3	10	10	5	3	2
50-99	40	30	10	17	13	10	10	10	10	10	10	10	10	7	3
100-199	50	40	10	23	17	10	14	14	12	10	10	10	10	10	10
200-299	60	50	10	30	20	10	18	16	16	10	14	12	12	12	10
300-399	70	60	10	37	23	10	22	20	18	10	17	15	14	14	10
400-499	80	70	10	43	27	10	25	23	22	10	19	18	17	16	10
500-799	90	80	10	50	30	10	29	27	24	10	22	21	19	18	10
>=800	100	90	10	57	33	10	33	31	26	10	25	23	22	20	10

8.2 Tier II Results

Two Tier II surveys were conducted by Aquatic Weed Control on Adams Lake in 2007. The first survey took place on June 8, 2007 and the second took place on July 27, 2007. Secchi depth was measured at 8.5 feet in the June survey and at 8.1 feet in the July survey. Twelve plant species were collected in June, while 13 plant species were collected in the July survey. Figure 9 shows all rake sample locations for the 2007 Tier II surveys on Adams Lake.

Figure 9: Adams Lake Rake Sample Locations



Tier II Data Analysis

The following tables are data summaries for the 2007 Tier II aquatic vegetation surveys. These tables help to describe the plant community, and will help identify any changes that take place in the years to come. Tables labeled “Overall” include every sample site in the survey, while the other tables describe each five foot depth contour of the lake’s littoral zone (0-5 feet, 5-10 feet, etc).

Calculations for these tables include null values for each sample site where no plants were collected.

June 2007 Data Analysis

Table 6: June 2007 Data Analysis - Overall

Occurrence and Abundance of Submersed Aquatic Plants - Overall					
Lake:	Adams	Secchi:	8.5	SE Mean Species/site:	0.16
Date:	6/8/07	Littoral sites with plants:	41	Mean natives/site:	1.13
Littoral depth (ft):	12.0	Number of species:	12	SE Mean natives/site:	0.13
Littoral sites:	50	Maximum species/site:	6	Species diversity:	0.76
Total sites:	60	Mean number species/site:	1.23	Native diversity:	0.72
		Score Frequency			
Common Name	Site Frequency	1	3	5	Dominance
Chara	45.0	13.3	26.70	5.00	23.7
Illinois Pondweed	36.7	18.3	18.30	0.00	14.7
Coontail	10.0	3.3	5.00	1.70	5.3
Sago Pondweed	8.3	1.7	6.70	0.00	4.3
Eurasian Watermilfoil	5.0	0.0	3.30	1.70	3.7
Curly-leaf Pondweed	5.0	0.0	5.00	0.00	3.0
Eel Grass	3.3	3.3	0.00	0.00	0.7
Small Pondweed	3.3	3.3	0.00	0.00	0.7
Richardson's Pondweed	1.7	0.0	0.00	1.70	1.7
Elodea	1.7	0.0	1.70	0.00	1.0
White Water Crowfoot	1.7	0.0	1.70	0.00	1.0
Nitella	1.7	1.7	0.00	0.00	0.3

Table 7: June 2007 Data Analysis 0 - 5 Feet

Occurrence and Abundance of Submersed Aquatic Plants 0-5 Feet					
Lake:	Adams	Secchi:	8.5	SE Mean Species/site:	0.31
Date:	6/8/07	Littoral sites with plants:	20	Mean natives/site:	1.64
Littoral depth (ft):	12.0	Number of species:	11	SE Mean natives/site:	0.19
Littoral sites:	22	Maximum species/site:	6	Species diversity:	0.78
Total sites:	22	Mean number species/site:	1.91	Native diversity:	0.72
			Score Frequency		
Common Name	Site Frequency	1	3	5	Dominance
Chara	72.7	18.2	45.50	9.10	40.0
Illinois Pondweed	40.9	18.2	22.70	0.00	17.3
Coontail	18.2	9.1	9.10	0.00	7.3
Eurasian Watermilfoil	13.6	0.0	9.10	4.50	10.0
Curly-leaf Pondweed	13.6	0.0	13.60	0.00	8.2
Sago Pondweed	9.1	4.5	4.50	0.00	3.6
Richardson's Pondweed	4.5	0.0	0.00	4.50	4.5
Elodea	4.5	0.0	4.50	0.00	2.7
White Water Crowfoot	4.6	0.0	4.50	0.00	2.7
Eel Grass	4.5	4.5	0.00	0.00	0.9
Nitella	4.5	4.5	0.00	0.00	0.9

Table 8: June 2007 Data Analysis 5 - 10 Feet

Occurrence and Abundance of Submersed Aquatic Plants 5-10 Feet					
Lake:	Adams	Secchi:	8.5	SE Mean Species/site:	0.19
Date:	6/8/07	Littoral sites with plants:	17	Mean natives/site:	1.30
Littoral depth (ft):	12.0	Number of species:	5	SE Mean natives/site:	0.19
Littoral sites:	20	Maximum species/site:	3	Species diversity:	0.68
Total sites:	20	Mean number species/site:	1.30	Native diversity:	0.68
			Score Frequency		
Common Name	Site Frequency	1	3	5	Dominance
Illinois Pondweed	55.0	30.0	25.00	0.00	1.0
Chara	45.0	15.0	25.00	5.00	23.0
Coontail	10.0	0.0	5.00	5.00	8.0
Sago Pondweed	10.0	0.0	10.00	0.00	6.0
Small Pondweed	10.0	10.0	0.00	0.00	2.0
Curly-leaf Pondweed	0.0	0.0	0.00	0.00	0.0
Eel Grass	0.0	0.0	0.00	0.00	0.0
Elodea	0.0	0.0	0.00	0.00	0.0
Eurasian Watermilfoil	0.0	0.0	0.00	0.00	0.0

Table 9: June 2007 Data Analysis 10 -15 Feet

Occurrence and Abundance of Submersed Aquatic Plants 10-15 Feet					
Lake:	Adams	Secchi:	8.5	SE Mean Species/site:	0.18
Date:	6/8/07	Littoral sites with plants:	4	Mean natives/site:	0.33
Littoral depth (ft):	12.0	Number of species:	4	SE Mean natives/site:	0.18
Littoral sites:	8	Maximum species/site:	3	Species diversity:	0.72
Total sites:	18	Mean number species/site:	0.33	Native diversity:	0.72
			Score Frequency		
Common Name	Site Frequency	1	3	5	Dominance
Chara	11.1	5.6	5.60	0.00	4.4
Illinois Pondweed	11.1	5.6	5.60	0.00	4.4
Sago Pondweed	5.6	0.0	5.60	0.00	3.3
Eel Grass	5.6	5.6	0.00	0.00	1.1

No plants were found deeper than 12.0 feet in the June 2007 survey.

July 2007 Data Analysis

Table 10: July 2007 Data Analysis - Overall

Occurrence and Abundance of Submersed Aquatic Plants - Overall					
Lake:	Adams	Secchi:	8.1	SE Mean Species/site:	0.2
Date:	7/27/07	Littoral sites with plants:	38	Mean natives/site:	1.32
Littoral depth (ft):	14.0	Number of species:	13	SE Mean natives/site:	0.18
Littoral sites:	58	Maximum species/site:	7	Species diversity:	0.83
Total sites:	60	Mean number species/site:	1.53	Native diversity:	0.80
			Score Frequency		
Common Name	Site Frequency	1	3	5	Dominance
Chara	40.0	18.3	11.70	10.00	20.7
Illinois Pondweed	38.3	18.3	20.00	0.00	15.7
Brittle Naiad	21.7	10.0	11.70	0.00	9.0
Coontail	10.0	3.3	6.70	0.00	4.7
Richardson's Pondweed	10.0	6.7	3.30	0.00	3.3
Slender Naiad	10.0	6.7	3.30	0.00	3.3
Sago Pondweed	10.0	8.3	1.70	0.00	2.7
Nitella	5.0	5.0	0.00	0.00	1.0
Bladderwort	1.7	1.7	0.00	0.00	0.3
Curly-leaf Pondweed	1.7	1.7	0.00	0.00	0.3
Elodea	1.7	1.7	0.00	0.00	0.3
Flat-stemmed Pondweed	1.7	1.7	0.00	0.00	0.3
Small Pondweed	1.7	1.7	0.00	0.00	0.3
Filamentous Algae	6.7				

Table 11: July 2007 Data Analysis 0 - 5 Feet

Occurrence and Abundance of Submersed Aquatic Plants 0-5 Feet					
Lake:	Adams	Secchi:	8.1	SE Mean Species/site:	0.027
Date:	7/27/07	Littoral sites with plants:	19	Mean natives/site:	1.68
Littoral depth (ft):	14.0	Number of species:	10	SE Mean natives/site:	0.24
Littoral sites:	22	Maximum species/site:	5	Species diversity:	0.80
Total sites:	22	Mean number species/site:	1.86	Native diversity:	0.76
			Score Frequency		
Common Name	Site Frequency	1	3	5	Dominance
Chara	63.6	31.8	9.10	22.70	34.5
Illinois Pondweed	45.5	22.7	22.70	0.00	18.2
Brittle Naiad	18.2	9.1	9.10	0.00	7.3
Coontail	13.6	4.5	9.10	0.00	6.4
Richardson's Pondweed	13.6	4.5	9.10	0.00	6.4
Sago Pondweed	13.6	9.1	4.50	0.00	4.5
Bladderwort	4.5	4.5	0.00	0.00	0.9
Elodea	4.5	4.5	0.00	0.00	0.9
Nitella	4.5	4.5	0.00	0.00	0.9
Slender Naiad	4.5	4.5	0.00	0.00	0.9
Filamentous Algae	18.2				

Table 12: July 2007 Data Analysis 5 - 10 Feet

Occurrence and Abundance of Submersed Aquatic Plants 5-10 Feet					
Lake:	Adams	Secchi:	8.1	SE Mean Species/site:	0.4
Date:	7/27/07	Littoral sites with plants:	1	Mean natives/site:	1.60
Littoral depth (ft):	14.0	Number of species:	10	SE Mean natives/site:	0.34
Littoral sites:	20	Maximum species/site:	7	Species diversity:	0.84
Total sites:	20	Mean number species/site:	2.00	Native diversity:	0.82
			Score Frequency		
Common Name	Site Frequency	1	3	5	Dominance
Illinois Pondweed	45.0	25.0	20.00	0.00	17.0
Brittle Naiad	40.0	15.0	25.00	0.00	18.0
Chara	40.0	20.0	15.00	5.00	18.0
Slender Naiad	25.0	15.0	10.00	0.00	9.0
Coontail	10.0	5.0	5.00	0.00	4.0
Nitella	10.0	10.0	0.00	0.00	2.0
Richardson's Pondweed	10.0	10.0	0.00	0.00	2.0
Sago Pondweed	10.0	10.0	0.00	0.00	2.0
Curly-leaf Pondweed	5.0	5.0	0.00	0.00	10.0
Flat-stemmed Pondweed	5.0	5.0	0.00	0.00	1.0

Table 13: July 2007 Data Analysis 10 - 15 Feet

Occurrence and Abundance of Submersed Aquatic Plants 10-15 Feet					
Lake:	Adams	Secchi:	8.1	SE Mean Species/site:	0.31
Date:	7/27/07	Littoral sites with plants:	4	Mean natives/site:	0.56
Littoral depth (ft):	14.0	Number of species:	7	SE Mean natives/site:	0.28
Littoral sites:	16	Maximum species/site:	4	Species diversity:	0.79
Total sites:	18	Mean number species/site:	0.61	Native diversity:	0.76
		Score Frequency			
Common Name	Site Frequency	1	3	5	Dominance
Illinois Pondweed	22.2	5.6	16.70	0.00	11.1
Chara	11.1	0.0	11.10	0.00	6.7
Coontail	5.6	0.0	5.60	0.00	3.3
Brittle Naiad	5.6	5.6	0.00	0.00	1.1
Richardson's Pondweed	5.6	5.6	0.00	0.00	1.1
Sago Pondweed	5.6	5.6	0.00	0.00	1.1
Small Pondweed	5.6	5.6	0.00	0.00	1.1

No plants were found deeper than 14.0 feet in the July 2007 survey.

Site Frequency

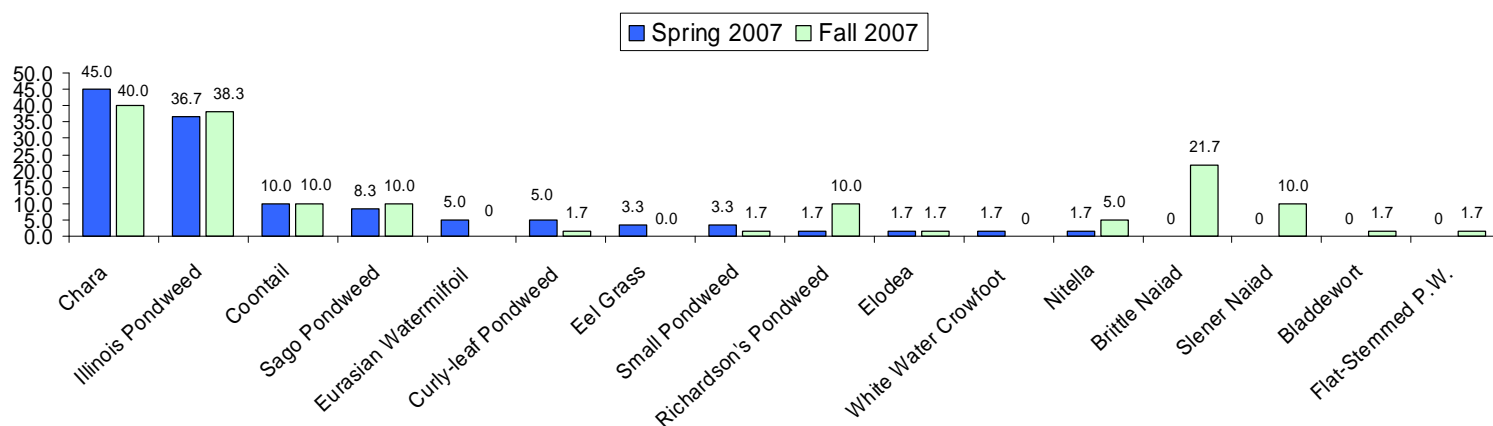
Site frequency is a measure of how often a species was collected during the Tier II survey. It can be calculated by the following equation:

$$\text{Site Frequency} = \left(\frac{\# \text{ of sites where the species was collected}}{\text{Total \# of littoral sample sites}} \right) \times 100$$

Table 14 shows site frequencies for every plant collected in the 2007 Tier II surveys. Chara and Illinois pondweed were by far the most frequently collected plants in both surveys. Brittle naiad showed the biggest change in frequency from spring to fall. It was not collected in the spring survey, but had a site frequency of 21.7 in the fall survey. Eurasian watermilfoil had a site frequency of 5.0 in spring, but was not collected in the fall survey after the 2, 4-D treatment.

Table 14: 2007 Site Frequencies

Adams Lake Site Frequencies - 2007



Species Diversity

The species diversity indices listed in the data analysis tables to describe the overall plant community. A species diversity index is actually measured as a value of uncertainty (H). If a species is chosen at random from a collection containing a certain number of species, the diversity index (H) is the probability that a chosen species will be different from the previous random selection. The diversity index (H) will always be between 0 and 1. The higher the H value, the more likely it is that the next species chosen from the collection at random will be different from the previous selection (Smith, 2001). This index is dependent upon species richness and species evenness, meaning that species diversity is a function of how many different species are present and how evenly they are spread throughout the ecosystem.

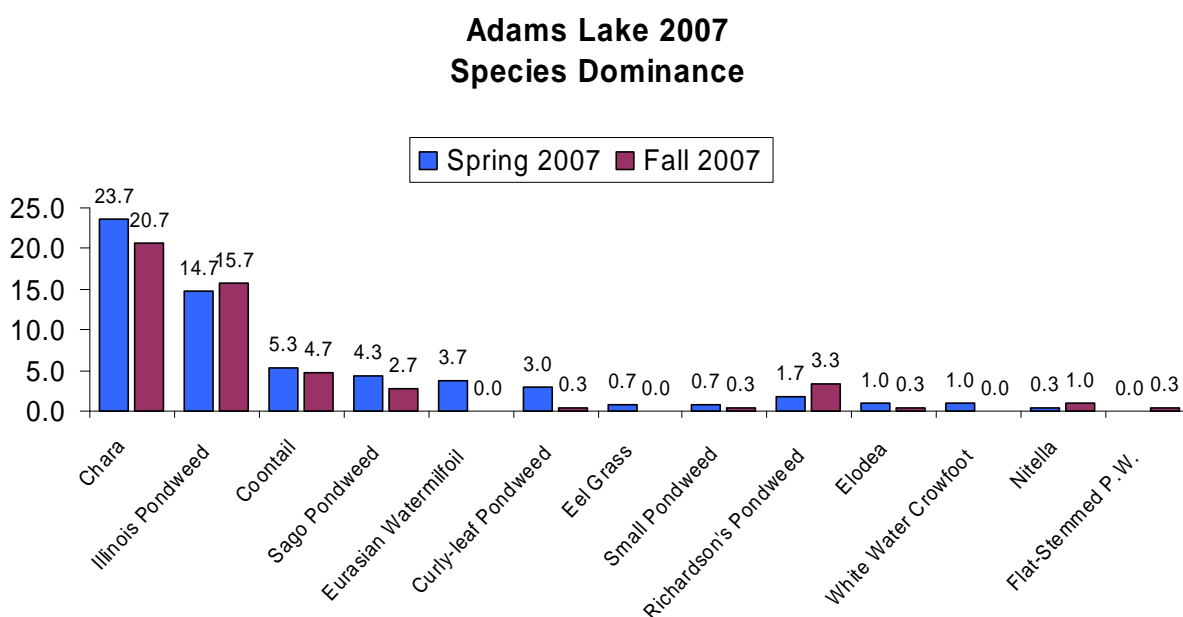
The species diversity index for Adams Lake in June of 2007 was 0.76 which is above average when compared with area lakes. Species diversity in July of 2007 was 0.83. Native species diversity scores were slightly lower, at 0.72 in June and 0.80 in July. This means that exotic species account for some of the diversity in Adams Lake.

Species Dominance

Species dominance is dependent upon how many times a species occurs and its relative coverage area or biomass within the system. In this survey, the abundance rating given to each species at each sample site was used to determine dominance. The dominance of a particular species in this Tier II survey increases as its site frequency and relative abundance increase.

Table 14 tracks dominance values for each plant collected at Adams Lake in 2007. Trends are similar to sight frequency, with Eurasian watermilfoil dominance being relatively low. Chara had the greatest dominance in both spring and fall, followed by Illinois pondweed and coontail.

Table 15: 2007 Species Dominance



8.3 Macrophyte Inventory Discussion

The submersed plant community of Adams Lake covers roughly 101 acres, or 33% of the lake's total surface area. Based upon 2007 survey data, Adams Lake has a submersed aquatic plant community with relatively high diversity when compared with many area lakes. Species richness in Adams Lake was 13 species in the July of 2007. The plant community is dominated by chara and Illinois pondweed, which are both beneficial, native plants. Eurasian watermilfoil is present in the lake, although it is not dominant and does not appear to be increasing in abundance. As more data is collected in the years to come, long term trends can be identified, and the health and diversity of the plant community can be more closely tracked.

Based on 2007 survey results, the 2, 4-D treatments appear to be successfully preventing the spread of Eurasian watermilfoil in Adams Lake. Eurasian watermilfoil was only collected in the east end of the lake near the public access site, so a whole lake treatment program is not necessary.

In summary, Adams Lake is characterized by a submersed plant community with high diversity (0.83), moderate water clarity (secchi depth 8.1 - 8.5 ft.) and a small area (~10 acres) of dense Eurasian watermilfoil in the silted east end of the lake.

9.0 Aquatic Plant Management Alternatives

Adams Lake currently has Eurasian watermilfoil present in the east end of the lake. Eurasian milfoil is believed to have arrived in North America in the mid 1940's and has spread throughout the east coast to northern Florida and the Midwest. Eurasian milfoil spreads by fragmentation and seed dispersal, and it has the ability to over-winter from year to year. Once it is in a lake it can become the dominant plant species because it forms dense canopies which shade out the native, more beneficial plant species below. There is also increasing evidence that mat forming species like Eurasian milfoil and curly leaf pondweed exert significant negative impacts on a broad range of aquatic organisms (Pullman, 1998)

Many management strategies have been used to control Eurasian milfoil in Indiana lakes. A management strategy should be chosen based on its selectivity of the pest in question, its long term effectiveness, and its environmental risks. The main goal of this plan is to choose a management option that can effectively control the Eurasian milfoil with little or no environmental risk, while causing no harm to native plant or fish species.

9.1 No Action

If no action is taken, the Eurasian milfoil abundance may increase from year to year. Eurasian milfoil grows by fragmentation, meaning that if the plant is cut, the fragment has the ability to form an entirely new plant. Eurasian milfoil also over-winters as an adult plant so new generations are created in each growing season. These reproductive characteristics cause milfoil beds become more dense over time, which can create a monoculture as it may eliminate more and more native species from a lake.

9.2 Institutional-Protection of Beneficial Vegetation

Lake users can play an important role in the protection of beneficial aquatic vegetation. Aquatic invasive species often gain a foothold in an ecosystem in areas disturbed by human activity or

natural processes. In many cases, boating may be restricted in certain areas of a lake to prevent harm to native plants, especially many emergent species. Boating lanes may be established through areas of emergent vegetations, and protected ecological zones may be created to prevent erosion off shoreline vegetation caused by intense wave action from boating activities. Shallow areas of a lake may also be marked with buoys to prevent injury to boaters and water skiers. It is important to obey boating restrictions to protect beneficial plant species and even prevent personal injury.

A healthy aquatic plant community is absolutely essential for the maintenance of a stable, diverse ecosystem. Aquatic plants provide habitat for plankton, insects, crustaceans, fish, and amphibians. They take nutrients like phosphorus and nitrogen out of the water column, increase water clarity, prevent harmful algal blooms, produce oxygen and provide food for waterfowl. Aquatic plants can even remove pollutants from contaminated water, and prevent the suspension of particulate matter by stabilizing sediment and preventing erosion from wave action or current.

The LARE aquatic vegetation management program recognizes the importance of beneficial aquatic vegetation and its protection is a top priority. The most basic goal for the LARE aquatic vegetation program is to maintain healthy aquatic ecosystems by maintaining or improving biodiversity in Indiana lakes. The purpose of conducting aquatic vegetation surveys is to document the overall health of plant communities and identify any ecosystem whose stability is threatened by invasive plant species.

Once a problem area is identified, a management strategy must be formulated that directly impacts the aquatic plant community in a positive way. While eradicating invasive plants is a major component of many management strategies, it is important to note the ultimate goal is not to eradicate aquatic vegetation, but to protect beneficial vegetation and protect lake ecosystems.

9.3 Environmental Manipulation

9.3.1 Water Level Manipulation

Draw down of the lake water level is one option that may help the Eurasian milfoil problem. Lower water levels expose the Eurasian milfoil roots to freezing and thawing, which may kill may kill milfoil root systems. However, a lake draw down will not only kill Eurasian milfoil, but native plants as well. Also, reducing the lake level would make new areas of the lake available for vegetative growth, and Eurasian milfoil may have an advantage in the colonization of these new areas if it is not eradicated prior to the lake draw down.

9.3.2 Nutrient Reduction

Limiting factors for plant growth include light, lake morphometry and depth, substrate and the availability of nutrients like phosphorus and nitrogen. While lake morphometry is most highly correlated with plant biomass, the availability of phosphorus and nitrogen have a tremendous impact on the amount of plant growth in a body of water. If the vast majority of phosphorus in a system is tied up in plant matter, it may be difficult for an invasive species to gain a foothold and spread rapidly in the lake. If phosphorus is constantly being added to the system and is readily available in the water, then invasive species will have an unlimited food supply should a disturbance create the opportunity for them to proliferate in a body of water.

Phosphorus and nitrogen are added to aquatic systems by many natural sources, such as the



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decomposition of plant material, and animal waste, but human activity is often responsible for excessive phosphorus loading that contributes to blue-green algal blooms, overabundant vegetation growth and a general decline in water quality. Major contributions of excess phosphorus come from sources such as septic system

inputs, agricultural runoff, storm water drainage, lawn fertilizer applications, , and improper disposal of grass clippings and tree leaves. Owners of lake front property can significantly reduce the amount of phosphorus entering the lake by taking actions outlined in the public education section.

9.4 Mechanical Controls

9.4.1 Mechanical Cutting and Harvesting

Mechanical harvesting uses a large machine to cut and collect unwanted aquatic plants. These machines pick up the cut weeds but will still leave small fragments that will have the ability to re-grow. Also, after an area is harvested the Eurasian milfoil generally re-grows first causing the



www.cleanlake.com

native plants to be shaded out again. Mechanical harvesting is also not selective in its control. The harvesting will cut the native plant species as well as the exotics if both are present in the same area. For these reasons, mechanical harvesting is not recommended. Harvesting can be accomplished by individual owners around their dock areas. A lake property owner can legally harvest a 625 square foot area. (25 feet by 25 feet).

9.5 Manual Controls

9.5.1 Hand Pulling, Cutting, Raking



www.ecy.wa.gov

Manual controls such as hand pulling, cutting and raking can be effective ways to control unwanted plants in certain situations. In very shallow clear water, small areas of vegetation can be identified and cleared effectively by hand. Large areas of vegetation, especially those in deeper water can be extremely difficult to control using these methods. Many of the harvested weeds will break apart, leaving the root

system in the lake bottom. Failure to remove root structures will result in re-growth.

Plants that possess the ability to reproduce through fragmentation can seldom be effectively controlled by these methods if they are distributed throughout a lake. Identifying every area of infestation would be difficult, as would harvesting the plants without causing fragmentation of individual plants. Any plant fragments not removed from the water can form new plants, meaning that hand pulling and cutting can facilitate the spread of the unwanted plant species.

9.5.2 Bottom Barriers

Bottom Barriers prevent the growth of aquatic plants by lining the bottom of a lake or pond with a material that prohibits light from reaching the lake bottom and that is difficult for plants to



penetrate. Many times, plastic or concrete barriers are used to prevent the growth of aquatic vegetation during construction of a lake or pond. This form of control is best implemented during construction of a new pond, and placing a bottom barrier in an existing lake would involve significant challenges and be extremely expensive. A draw down of the lake may be necessary install the barrier, and if the lake level is not regulated by control structures, this can be almost impossible. For a large lake, material costs alone would be enormous.

Once in place, the barrier would prevent not only invasive plant growth, but native plant growth as well, destabilizing the lake ecosystem and having a negative impact on insect and fish communities. Sediment would gradually accumulate on top of the barrier, and aquatic plant growth would return as plants begin to take root in the sediment on top of the barrier. An IDNR permit is required for the placement of a bottom Barrier.

9.6 Biological Controls

9.6.1 Water Milfoil Weevil



The watermilfoil weevil is a native North American insect that consumes Eurasian milfoil and northern milfoil. The weevil was discovered after a decline in the Eurasian milfoil population was observed in Brownington Pond, Vermont (Creed and Sheldon, 1993). The milfoil weevil burrows down into the stem of the plant and consumes the tissue of the plant. Holes in the milfoil stem bored by weevil larvae allow disease to enter the plant. These same holes also cause a

release of the plants' gases which reduces buoyancy and causes the plant to sink (Creed et. Al. 1992).

Studies conducted to evaluate the effectiveness of the water milfoil weevil have not yielded consistent results. Factors influencing the weevil's success or failure in a body of water are not

well documented. In 2003, Scribailo and Alix conducted a weevil test on Round Lake in Indiana and found no conclusive evidence that the Eurasian milfoil populations were reduced. An IDNR permit is required for the stocking of the watermilfoil weevil.

9.6.2 Grass Carp

The Asian grass carp or white amur (*Ctenopharyngodon idella*) is an herbivorous fish that is native to eastern Russia and China. This fish has been introduced into the U.S. to help control aquatic vegetation. To prevent their uncontrolled proliferation, all fish stocked in Indiana must be triploid, meaning that they cannot reproduce. Stocking is restricted to privately owned bodies



www.tpwd.state.tx.us

of water, and suppliers must obtain a special permit from the IDNR. Grass carp are completely vegetarian, feeding on many species of submersed plants, along with some floating plants such as duckweed. Hydrilla, a highly invasive plant found in many southern states is a preferred food of grass carp and

efforts to control hydrilla with grass carp have been successful.

According to the Aquatic Ecosystem Restoration Foundation, grass carp avoid Eurasian milfoil, and show strong preferences for many native plants along with hydrilla. The success of grass carp stockings is highly dependent upon the food sources available to the fish. When Eurasian milfoil occurs along with native plant populations, grass carp are not recommended. Grass carp are not currently permitted for stocking in public waters.

9.7 Chemical Controls

9.7.1 Aquatic Herbicides

There are two major categories of aquatic herbicides: contact and systemic herbicides. Contact herbicides are used best to control the majority of the weeds close to shore, around piers and in man-made channels. Examples of contact herbicides are Reward (active ingredient: diquat), and Aquathal (active ingredient: endothal).

Contact herbicides would not be a wise choice for a whole lake treatment because of their lack of selectivity and their inability to eliminate the root systems of treated plants. These characteristics could result in unnecessary damage to native species, as well as greater potential for the re-infestation of Eurasian milfoil.

Systemic herbicides are absorbed by the plant and transported to the root systems where they eliminate both the roots and the plant. Examples of systemic herbicides are Sonar and Avast (active ingredient: fluridone), Navigate, Aqua Kleen, DMA4 (active ingredient 2, 4-D) and Renovate (active ingredient: triclopyr). All of these chemicals effectively kill Eurasian milfoil plants and roots. Based on the author's experience and other lake managers in the Midwest, whole lake treatments using fluridone are the most effective way to control Eurasian water milfoil in lakes that have become severely infested. Fluridone can be applied at low rates to control the Eurasian milfoil while causing little or no harm to the majority of the native weed species present in the lake.

2, 4-D and Renovate (active ingredient: triclopyr) are both root control herbicides which can be used for spot treatments in small areas of Eurasian milfoil infestation, while the whole lake

must be treated if Sonar (fluridone) is used. The major difference between 2, 4-D and triclopyr is that triclopyr may have the ability to control the Eurasian milfoil longer than 2,4-D. Renovate (triclopyr) has only been available for use for the past three seasons, and the ability of Renovate to provide more long term control of Eurasian milfoil than 2,4-D in spot treatment situations is still being documented. 2, 4-D is less expensive to use but if triclopyr shows better long term control in treated areas it may become the most cost effective long term investment.

The public's primary concern with the use of aquatic herbicides is safety. Every chemical registered for aquatic applications has undergone extensive testing prior to becoming available for use. These tests demonstrate that when these herbicides are applied properly at labeled rates, they are safe for humans and will not directly cause any adverse environmental effects.

10.0 Public Involvement

A LARE meeting was held on November 8, 2007 to discuss issues pertaining to Adams Lake. District 2 Fisheries Biologists Neil Ledet and Lary Koza, a lake representative, Aquatic Weed Control and LARE Aquatic biologists Angela Sturdevant and Gwen White were all present and discussed the plant community of Adams Lake. Discussion at this meeting helped to develop the 2008 management strategy.

A public lake meeting was held for Adams Lake on August 25, 2007. Jim Donahoe of Aquatic Weed Control summarized LARE management activities and outlined the treatment strategy to help contain the Eurasian watermilfoil population in the lake.

Public questionnaires were handed out at the public lake association meeting. Many residents were happy that the Eurasian watermilfoil distribution remains isolated in the east end of the lake. Residents expressed that if at all possible, it would be beneficial to treat the Eurasian watermilfoil in Adams Lake earlier in the year. Table 16 is a summary of the 2007 public questionnaires.

Table 16: Public Questionnaire

Lake Use Survey (18 total) Lake name Adams Lake

Are you a lake property owner? Yes 18 No 0

Are you currently a member of your lake association? Yes 18 No 0

How many years have you been at the lake? 2 or less - 1
 2 - 5 years - 0
 5-10 years - 4
 Over 10 years - 13

How do you use the lake (mark all that apply)

<u>17</u> Swimming	<u>1</u> Irrigation
<u>15</u> Boating	<u>0</u> Drinking water
<u>11</u> Fishing	<u>1</u> Other _____

Do you have aquatic plants at your shoreline in nuisance quantities? Yes 10 No 8

Do you currently participate in a weed control project on the lake? Yes 9 No 9

Does aquatic vegetation interfere with your use or enjoyment of the lake? Yes 8 No 9

Does the level of vegetation in the lake affect your property values? Yes 9 No 8

Are you in favor of continuing efforts to control vegetation on the lake? Yes 16 No 0

Are you aware that the LARE funds will only apply to work controlling invasive exotic species, and more work may need to be privately funded? Yes 18 No 0

Mark any of these you think are problems on your lake:

- 3 Too many boats access the lake
- 1 Use of jet skis on the lake
- 2 Too much fishing
- 0 Fish population problem
- 4 Dredging needed
- 3 Overuse by nonresidents
- 7 Too many aquatic plants
- 0 Not enough aquatic plants
- 2 Poor water quality
- 0 Pier/funneling problem

Please add any comments:

Algae in channel; wake damage to shoreline caused by new wake boats that are too big for our lake (Adams Lake is only 300 acres); Jet skis too noisy!!! - make alot of waves for boat skiers; larger boats are causing some significant problems; Weed control is working; boat ramp area needs better control for weeds; we need weeds to keep the fish places to get food; jet skis run too fast in closer than the 200 foot limit.

11.0 Public Education

Lake residents play an important role in establishing and maintaining a healthy lake community. Lake association meetings and newsletters are excellent avenues through which this information about management practices on Adams Lake can be distributed. These meetings can also help to inform the public about practical steps that they can take to improve Adams Lake. The following information is designed to give practical suggestions on ways that lake residents can reduce nutrient loading and improve the Adams Lake ecosystem.

1. **Ensure that existing homes be connected to a properly maintained lake wide sewer system if possible.** Many older homes possess septic systems without proper filter beds. Some systems may have significant leaks, while some may drain into the lake. Sewage leaks add tremendous amounts of nutrients to the water, along with harmful bacteria. If a lake does not have a sewer system, the proper maintenance of septic tanks and filter beds can help reduce nutrient loading.
2. **Limit lawn fertilizer use in areas where runoff will enter the lake.** If a fertilizer application must be applied, avoid spreading fertilizer directly into the lake, on sidewalks, or sea walls where it will wash into the lake. Try to avoid applying fertilizer within 30 feet of the shoreline. If fertilizer must be used, low phosphorus or no phosphorus fertilizer is preferred for use.
3. **Work with farmers within the lake catchment to increase proper filtration and drainage of agricultural land before runoff reaches the lake.** The Indiana state government offers incentives for farmers to address soil and water concerns through the U.S. Department of Agriculture. The Indiana Conservation Reserve Program (CRP) provides technical and financial aid to reduce soil erosion, reduce sediment in lakes and streams, and improve overall water quality. Farmers owning highly erodible land or property adjacent to tributary streams or lakes may be eligible for funding that can increase water quality significantly. Further information can be found at www.in.nrcs.usda.gov/programs/CRP/crphomepage.html or by contacting the following address.
 Indiana NRCS
 6013 Lakeside Boulevard
 Indianapolis, Indiana 46278-2933
 Phone: (317) 290-3200
 FAX: (317) 290-3225
4. **Avoid blowing grass clippings and tree leaves into the lake.** Many pond owners know that grass clippings blown into a pond can turn into a floating mat of algae in only a few days. This occurs because cut and decaying vegetation rapidly releases nutrients into the water.
5. **Prevent or reduce urban and industrial runoff flowing directly into the lake.** Urban runoff can be one of the most detrimental factors influencing water quality. Not only are nutrients and sediment carried to lakes through storm sewers, but harmful contaminants as well. Oil, antifreeze, gasoline, road salt, and other pollutants are washed from pavement and can all end up harming a lake ecosystem.

The following are practical steps recommended by the United States Environmental Protection Agency to reduce urban runoff:

- a) Protect areas that provide important water quality benefits or are particularly susceptible to erosion or sediment loss.
- b) Limit land disturbance such as clearing and grading and cut fill to reduce erosion and sediment loss.
- c) Limit disturbance of natural drainage features and vegetation.
- d) Place bridge structures so that sensitive and valuable aquatic ecosystems are protected.
- e) Prepare and implement an approved erosion control plan.
- f) Ensure proper storage and disposal of toxic material.
- g) Incorporate pollution prevention into operation and maintenance procedures to reduce pollutant loadings to surface runoff.
- h) Develop and implement runoff pollution controls for existing road systems to reduce pollutant concentrations and volumes.

Further information about urban runoff in Indiana can be obtained by contacting the EPA Region 5 National Pollution Discharge Elimination System Storm Water Coordinator by calling (312) 886-6100.

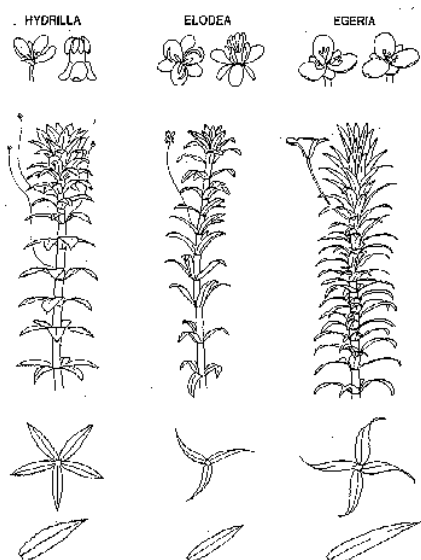
6. **Establish ecological zones to protect existing wetlands and emergent vegetation from turbulence caused by boats.** Wetlands not only filter water, but they also stabilize shoreline areas that would otherwise be highly erodable. Submersed and emergent vegetation can be eliminated by heavy wave action, which destabilizes the shoreline and reduces the lake's natural defense against sediment and nutrient loading. It is extremely important to make sure that existing wetlands remain intact to aid in the natural water purification process. If possible lake associations should identify significant wetland areas and work with the IDNR to protect them from drainage and disruption.

Hydrilla

Hydrilla (*Hydrilla verticillata*) is an invasive aquatic plant species common throughout the southern United States. It is federally listed as a noxious weed and causes severe ecological and recreational problems wherever it grows. It is considered to be much more destructive than other invasives like Eurasian watermilfoil and curly leaf pondweed because of its reproductive adaptations. It grows by fragmentation, as does Eurasian watermilfoil, but it also produces turions which can remain dormant in the sediment for 4 years or more (Van and Steward, 1990). It produces tubers at its root tips which can also reproduce after multiple years of dormancy. It can grow 1 inch each day and it quickly out-competes native plants. It forms dense beds that eliminate native plants, stunt fish populations, impede recreation and cause a drastic decrease in biodiversity (Colle and Shireman, 1980). Millions of dollars are spent each year for hydrilla maintenance each year in Florida alone. Eradication is unlikely once a population has been well established, although eradication has been achieved in newly infested waters using a herbicide called Sonar. Sonar



is applied at a rate of 6 parts per billion and this concentration is maintained in the water for 180 days. Early detection can be crucial to an effective eradication program, and all lake residents and



users are encouraged to be on the look-out for this invader. In fall of 2006, this plant was found in Lake Manitou, in Rochester, Indiana. This is the first instance of hydrilla in the upper Midwest. Prior to its appearance in Lake Manitou, The closest infestations of hydrilla were in Tennessee and Pennsylvania.

Hydrilla can easily be confused with native elodea. The major difference is that elodea has sets of leaves on the stem in whorls of three, while hydrilla usually has whorls of 5 leaves, although 4 to 9 leaves per whorl are possible with hydrilla. Hydrilla will also have small serrations on the leaf edges. More information on hydrilla can be found at the University of Florida's Center for Aquatic Invasive Plants (<http://plants.ifas.ufl.edu/>). More general information on aquatic invaders can be found at www.protectyourwaters.net.

12.0 Integrated Management Action Strategy

The 2008 treatment plan will use 2, 4-D to provide control of Eurasian watermilfoil in areas of infestation. Areas of milfoil infestation are currently estimated at up to 13 acres. The main area of concern is the east end of the lake near the public access site. Exact treatment areas will depend upon results of a spring 2008 visual survey. A treatment map will be submitted to the IDNR, and should funding be available, up to 90% of treatment costs may be covered by the LARE program.

It is important to note that Eurasian watermilfoil will be the only plant species specifically targeted in this project, as LARE funds will only be awarded for the control of invasive plant species. The goal is not to eliminate vegetation in Adams Lake, but to improve the health of the plant community. Native vegetation will still be abundant in shallow areas after treatment, and control of these natives must be privately funded. The goal will be to reduce the Eurasian watermilfoil population and allow for the recovery of native plant species that will provide better fish habitat, foster good water quality and pose less interference to recreational use of the lake.

Herbicide Specifications

In treatment areas on Adams Lake 2, 4-D should be applied at a rate of 1.76 parts per million to achieve adequate control of Eurasian Watermilfoil.

13.0 Project Budget

Cost estimates for 2008 are included below. These figures are estimates only and are subject to change pending 2008 chemical pricing.

Project	Total Cost	LARE Share	Association Share
Treat up to 13 acres in Adams Lake with 2, 4-D for Eurasian watermilfoil	Up to \$4,875	Up to \$4,387.50	Up to \$487.50
2008 Plant Surveys and Plan update	Up to \$4,000	Up to \$3,600	Up to \$400
Totals	Up to \$8,875	Up to 7,987.50	\$887.50

14.0 Monitoring and plan Update Procedures

A visual inspection should be used in spring of 2008 to monitor the Eurasian watermilfoil population in Adams Lake. Adams Lake has good water clarity (secchi depth 8.1-8.5 feet), which makes visual inspections very efficient and effective. This visual survey will be used to develop a Eurasian watermilfoil treatment map which will be submitted to the IDNR for approval. Should the proposed treatment areas be approved, the LARE funded herbicide treatment will then take place.

A late season Tier II quantitative vegetation survey will also be conducted in 2008. This survey will take place after the LARE funded herbicide treatment, and will be used to evaluate populations of both native and invasive plants in Adams Lake.

15.0 References

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16.0 Appendices

16.1 Calculations

Fluridone Calculations:

The following paragraph is taken directly from the Sonar A.S. label. It outlines the specific procedures for calculating the amount of Fluridone needed to treat a body of water.

Application Rate Calculation - Ponds, Lakes and Reservoirs

The amount of Sonar A.S. to be applied to provide the desired ppb concentration of active ingredient in treated water may be calculated as follows:

Quarts of Sonar A.S. required per treated surface acre =
Average water depth of treatment site (feet)
x Desired ppb concentration of active ingredient
x 0.0027

For example, the quarts per acre of Sonar A.S. required to provide a concentration of 25 ppb of active ingredient in water with an average depth of 5 feet is calculated as follows:

$5 \times 25 \times 0.0027 = 0.33$ quarts per treated surface acre
When measuring quantities of Sonar A.S., quarts may be converted to fluid ounces by multiplying quarts to be measured x 32. For example, $0.33 \text{ quarts} \times 32 = 10.5$ fluid ounces.

Note: Calculated rates should not exceed the maximum allowable rate in quarts per treated surface acre for the water depth listed in the application rate table for the site to be treated.

The following chart outlines rate calculations for DMA – 4 IVM Herbicide. It was taken directly from the DMA – 4 IVM specimen label on Dow AgroSciences website. <http://www.dowagro.com/ivm/invasive/prod/dma.htm>

Submerged Aquatic Weeds: Including Eurasian Water Milfoil (*Myriophyllum spicatum*)

Treatment Site	Maximum Application Rate [†]	Specific Use Directions
Aquatic Weed Control in Ponds, Lakes, Reservoirs, Marshes, Bayous, Drainage Ditches, Canals, Rivers and Streams that are Quiescent or Slow Moving, Including Programs of the Tennessee Valley Authority	2.84 gallons (10.8 lb of acid equivalent) per acre foot	<p>Application Timing: For best results, apply in spring or early summer when aquatic weeds appear. Check for weed growth in areas heavily infested the previous year. A second application may be needed when weeds show signs of recovery, but no later than mid-August in most areas.</p> <p>Subsurface Application: Apply DMA 4 IVM undiluted directly to the water through a boat mounted distribution system. Shoreline areas should be treated by subsurface injection application by boat to avoid aerial drift.</p> <p>Surface Application: Use power operated boat mounted boom sprayer. If rate is less than 5 gallons per acre, dilute to a minimum spray volume of 5 gallons per surface acre.</p> <p>Aerial Application: Use drift control spray equipment or thickening agents mixed with sprays to reduce drift. Apply through standard boom systems in a minimum spray volume of 5 gallons per surface acre. For Microfoil® drift control spray systems, apply DMA 4 IVM in a total spray volume of 12 to 15 gallons per acre.</p> <p>Apply to attain a concentration of 2 to 4 ppm (see table below).</p>

[†] DMA 4 IVM contains 3.8 lb of acid equivalent per gallon of product.

Amount to Apply to Attain a Concentration of 2 to 4 ppm			
Surface Area	Average Depth (ft)	2,4-D Acid Equivalent to Apply (lb/acre)	Amount of DMA 4 IVM to Apply (gal/acre)
1 acre	1	5.4 to 10.8	1.42 to 2.84
	2	10.8 to 21.6	2.84 to 5.68
	3	16.2 to 32.4	4.26 to 8.53
	4	21.6 to 43.2	5.68 to 11.37
	5	27.0 to 54.0	7.10 to 14.21

The following table outlines rate calculations for Renovate 3 herbicide based on desired PPM and average depth of treatment area. It is taken directly from the Renovate 3 specimen label on SePRO Corporation's website: www.sepro.com

Concentration of Triclopyr Acid in Water (ppm ae)					
	Gallons of Renovate 3 per surface acre at specified depth				
Water Depth (feet)	0.75 ppm	1.0 ppm	1.5 ppm	2.0 ppm	2.5 ppm
1	0.7	0.9	1.4	1.8	2.3
2	1.4	1.8	3.3	3.6	4.6
3	2.1	2.9	4.1	5.4	6.8
4	2.7	3.6	5.4	7.2	9.1
5	3.4	4.5	6.8	9.0	11.3
6	4.1	5.4	8.1	10.9	13.6
7	4.8	6.3	9.5	12.7	15.8
8	5.5	7.2	10.9	14.5	18.1
9	6.1	8.1	12.2	16.3	20.4
10	6.8	9.0	13.6	18.1	22.6
15	10.2	13.6	20.4	27.2	33.9
20	13.6	18.1	27.2	36.2	45.3

16.2 Common Aquatic Plants of Indiana

16.3 Pesticide Use Restrictions Summary:

The following table was produced by Purdue University and included in the Professional Aquatic Applicators Training Manual. It gives a summary of water use restrictions on all major chemicals available for use in the aquatics market.

Table 17: Pesticide Use Restrictions

Table 1. Aquatic Herbicides and Their Use Restrictions. Always check the label because these restrictions are subject to change.

	Human			Animal	Irrigation		
	Drinking	Swimming	Fish Consumption	Drinking	Turf	Forage	Food Crops
----- waiting period, in days -----							
Copper Chelate	0	0 ^a	0	0	0	0	0
Copper Sulfate	0	0 ^a	0	0	0	0	0
Diquat	1-3	0 ^a	0	1	1-3	1-3	5
Endothall (granular) ^b	7	0 ^a	3	0	7	7	7
Endothall (liquid) ^b	7-25	0 ^a	3	7-25	7-25 ^d	7-25	7-25
Endothall 191 (granular) ^c	7-25	0 ^a	3	7-25	7-25	7-25	7-25
Endothall 191 (liquid) ^c	7-25	0 ^a	3	7-25	7-25	7-25	7-25
Fluridone	0 ^e	0 ^a	0	0	7-30	7-30	7-30
Glyphosate	0 ^e	0 ^a	0	0	0	0	0
2,4-D (granular)	*	0 ^a	0	*	*	*	*

^aAlthough this compound has no waiting period for swimming, it is always advisable to wait 24 hours before permitting swimming in the direct area of treatment.

^bTrade name is Aquathol®.

^cTrade name is Hydrothol®.

^dMay be used for sprinkling bent grass immediately.

^eDo not apply this product within 1/4 (fluridone) to 1/2 (glyphosate) mile upstream of potable water intakes.

*Do not use treated water for domestic purposes, livestock watering (2,4-D, dairy animals only), or irrigation.

16.4 Resources for Aquatic Management

In addition to the LARE Program, there are many other sources of potential funding to help improve the quality of Indiana Lakes. Many government agencies assist in projects designed to improve environmental quality.

The USDA has many programs to assist environmental improvement. More information on the following programs can be found at www.usda.gov.

Watershed Protection and Flood Prevention Program (USDA)

Conservation Reserve Program (USDA)

Wetlands Reserve Program (USDA)

Grassland Reserve Program (USDA)

Wildlife Habitat Incentive Program (USDA)

Small Watershed Rehabilitation Program (USDA)

The following programs are offered by the U.S. Fish and Wildlife Service. More information about the Fish and Wildlife service can be found at www.fws.gov

Partners for Fish and Wildlife Program (U.S. Fish and Wildlife Service)

Bring Back the Natives Program (U.S. Fish and Wildlife Service)

Native Plant Conservation Program (U.S. Fish and Wildlife Service)

The Environmental Protection Agency, the Indiana Department of Environmental Management, and the U.S. Forest Service also have numerous programs for funding. A few of these are listed below. More information can be found at www.in.gov/idem and www.fs.fed.us/

U.S. Environmental Protection Agency Environmental Education Program (EPA)

NPDES Related State Program Grants (IDEM)

Community Forestry Grant Program (U.S. Forest Service)

16.5 State Regulations for Aquatic Plant Management

The following information is found on the IDNR website and outlines general regulations for the management of aquatic plants in public waters.

AQUATIC PLANT CONTROL PERMIT REGULATIONS

Indiana Department of Natural Resources

Note: In addition to a permit from IDNR, public water supplies cannot be treated without prior written approval from the IDEM Drinking Water Section. **Amended state statute adds biological and mechanical control (use of weed harvesters) to the permit requirements, reduces the area allowed for treatment without a permit to 625 sq ft, and updates the reference to IDEM. These changes become effective on July 1, 2002.**

Chapter 9. Regulation of Fishing

IC 14-22-9-10

Sec. 10. (a) This section does not apply to the following:

- (1) A privately owned lake, farm pond, or public or private drainage ditch.
- (2) A landowner or tenant adjacent to public waters or boundary waters of the state, who chemically, mechanically, or physically controls aquatic vegetation in the immediate vicinity of a boat landing or bathing beach on or adjacent to the real property of the landowner or tenant if the following conditions exist:

- (A) The area where vegetation is to be controlled does not exceed:
 - (i) twenty-five (25) feet along the legally established, average, or normal shoreline;
 - (ii) a water depth of six (6) feet; and
 - (iii) a total surface area of six hundred twenty-five (625) square feet.
- (B) Control of vegetation does not occur in a public waterway of the state.

(b) A person may not chemically, mechanically, physically, or biologically control aquatic vegetation in the public waters or boundary waters of the state without a permit issued by the department. All procedures to control aquatic vegetation under this section shall be conducted in accordance with rules adopted by the department under IC 4-22-2.

(c) Upon receipt of an application for a permit to control aquatic vegetation and the payment of a fee of five dollars (\$5), the department may issue a permit to the applicant. However, if the aquatic vegetation proposed to be controlled is present in a public water supply, the department may not, without prior written approval from the department of environmental management, approve a permit for control of the aquatic vegetation.

(d) This section does not do any of the following:

- (1) Act as a bar to a suit or cause of action by a person or governmental agency.
 - (2) Relieve the permittee from liability, rules, restrictions, or permits that may be required of the permittee by any other governmental agency.
 - (3) Affect water pollution control laws (as defined in IC 13-11-2-261) and the rules adopted under water pollution control laws (as defined in IC 13-11-2-261).
- As added by P.L.1-1995, SEC.15. Amended by P.L.1-1996, SEC.64.

312 IAC 9-10-3 Aquatic vegetation control permits

Authority: IC 14-22-2-6; IC 14-22-9-10

Affected: IC 14-22-9-10

Sec. 3. (a) Except as provided under IC 14-22-9-10(a), a person shall obtain a permit under this section before applying a substance to waters of this state to seek aquatic vegetation control.

(b) An application for an aquatic vegetation control permit shall be made on a departmental form and must include the following information:

- (1) The common name of the plants to be controlled.
- (2) The acreage to be treated.
- (3) The maximum depth of the water where plants are to be treated.
- (4) The name and amount of the chemical to be used.

(c) A permit issued under this section is limited to the terms of the application and to conditions imposed on the permit by the department.

(d) Five (5) days before the application of a substance permitted under this section, the permit holder must post clearly, visible signs at the treatment area indicating the substance that will be applied and what precautions should be taken.

(e) A permit issued under this section is void if the waters to be treated are supplied to the public by a private company or governmental agency. (Natural Resources Commission; 312

16.6 Public Questionnaire

Lake Use Survey (18 total) Lake name Adams Lake

Are you a lake property owner? Yes 18 No 0

Are you currently a member of your lake association? Yes 18 No 0

How many years have you been at the lake? 2 or less - 1
2 - 5 years - 0
5-10 years - 4
Over 10 years - 13

How do you use the lake (mark all that apply)

<u>17</u> Swimming	<u>1</u> Irrigation
<u>15</u> Boating	<u>0</u> Drinking water
<u>11</u> Fishing	<u>1</u> Other _____

Do you have aquatic plants at your shoreline in nuisance quantities? Yes 10 No 8

Do you currently participate in a weed control project on the lake? Yes 9 No 9

Does aquatic vegetation interfere with your use or enjoyment of the lake? Yes 8 No 9

Does the level of vegetation in the lake affect your property values? Yes 9 No 8

Are you in favor of continuing efforts to control vegetation on the lake? Yes 16 No 0

Are you aware that the LARE funds will only apply to work controlling invasive exotic species, and more work may need to be privately funded? Yes 18 No 0

Mark any of these you think are problems on your lake:

- 3 Too many boats access the lake
- 7 Use of jet skis on the lake
- 2 Too much fishing
- 0 Fish population problem
- 4 Dredging needed
- 3 Overuse by nonresidents
- 7 Too many aquatic plants
- 0 Not enough aquatic plants
- 2 Poor water quality
- 0 Pier/funneling problem

Please add any comments:

Algae in channel; wake damage to shoreline caused by new wake boats that are too big for our lake (Adams Lake is only 300 acres); Jet skis too noisy!!! - make a lot of waves for boat skiers; larger boats are causing some significant problems; Weed control is working; boat ramp area needs better control for weeds; we need weeds to keep the fish places to get food; jet skis run too fast in closer than the 200 foot limit.

16.7 Species Distribution Maps

Figure 10: 2007 Rake Sample Locations

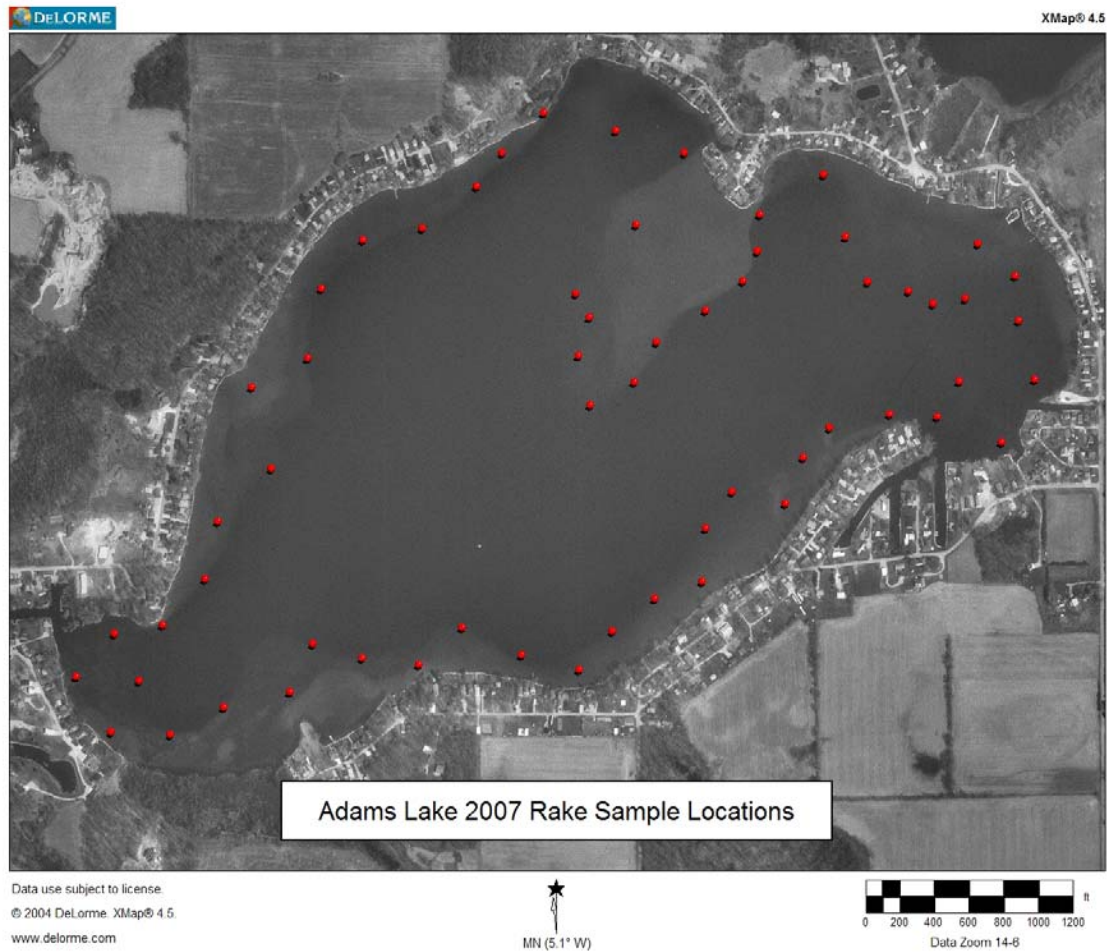


Figure 11: June 2007 Chara Locations

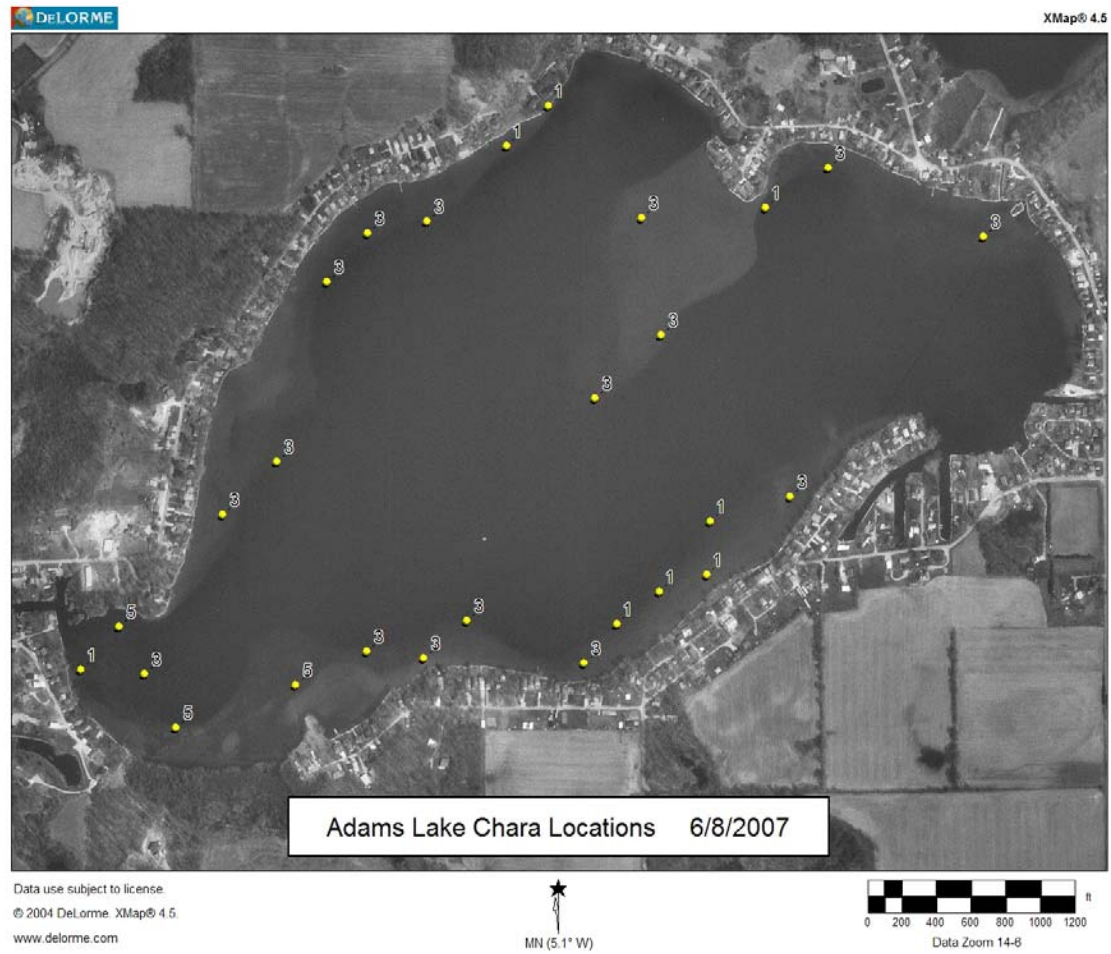


Figure 12: June 2007 Coontail Locations

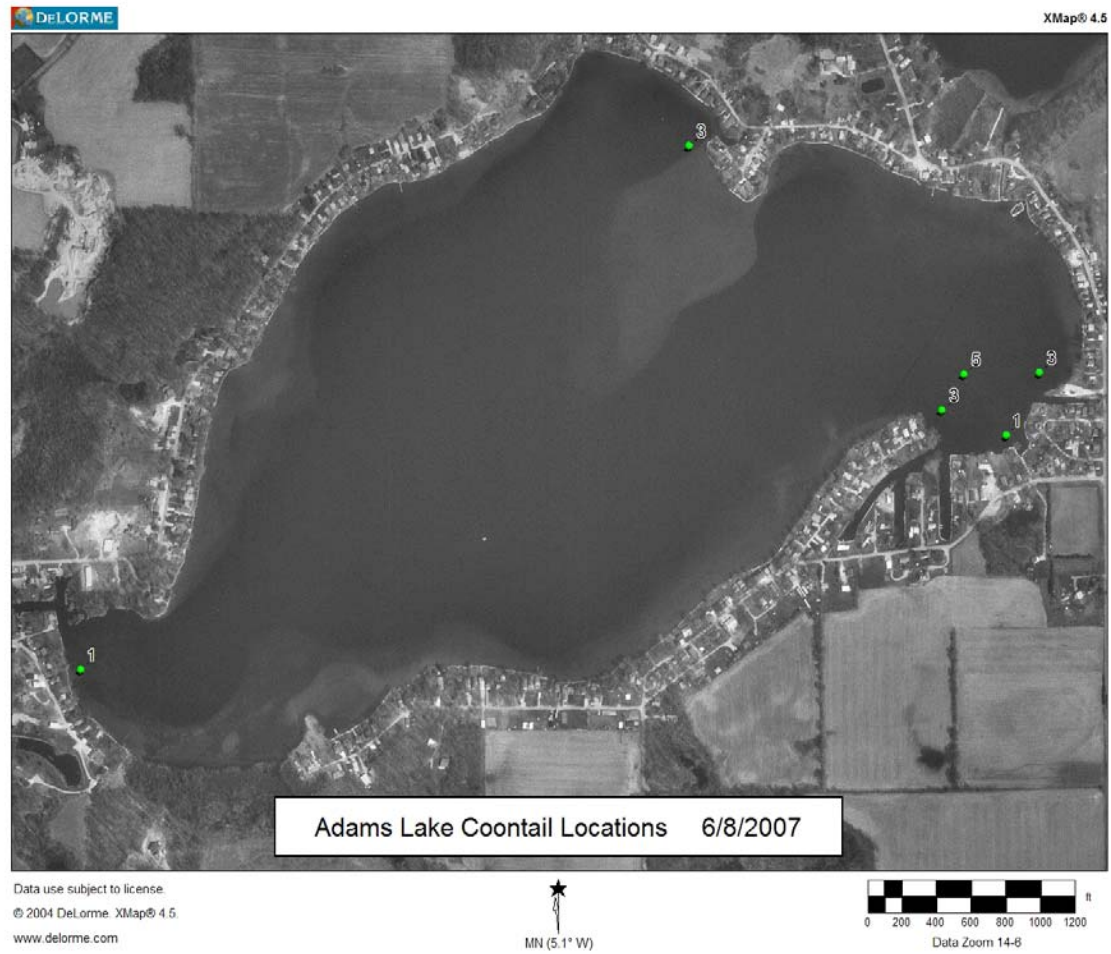


Figure 13: June 2007 White Water Crowfoot



Figure 14: June 2007 Curly Leaf Pondweed Locations

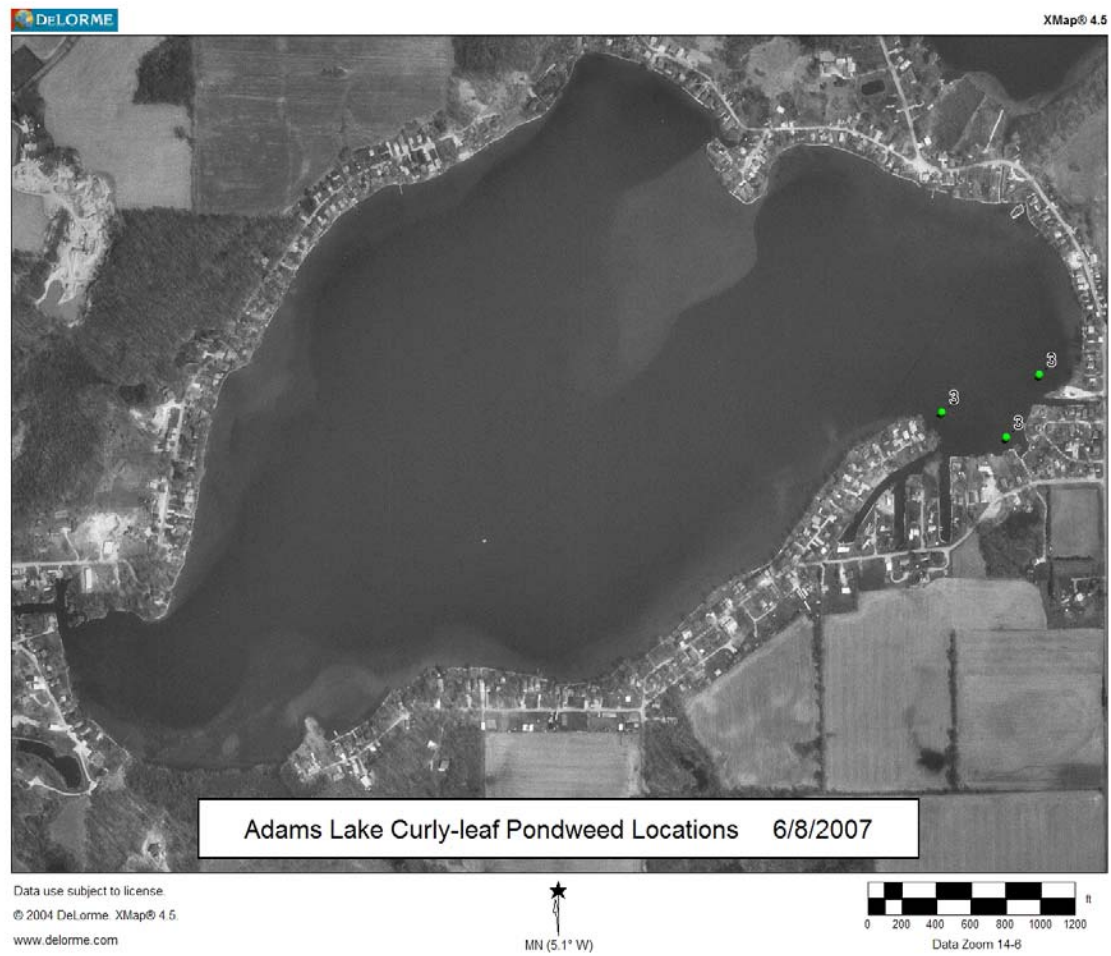


Figure 15: June 2007 Eel Grass Locations

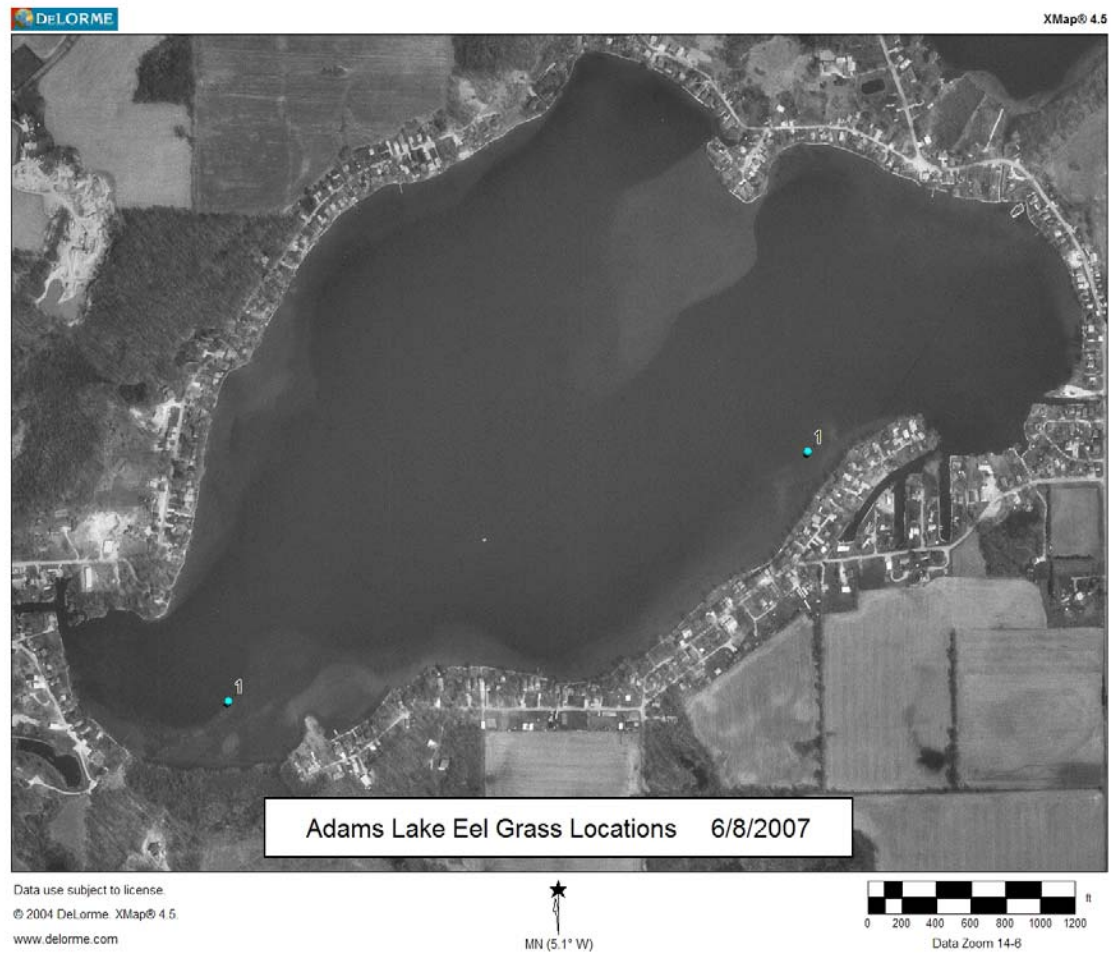


Figure 16: June 2007 Elodea Locations



Figure 17: June 2007 Eurasian Watermilfoil Locations

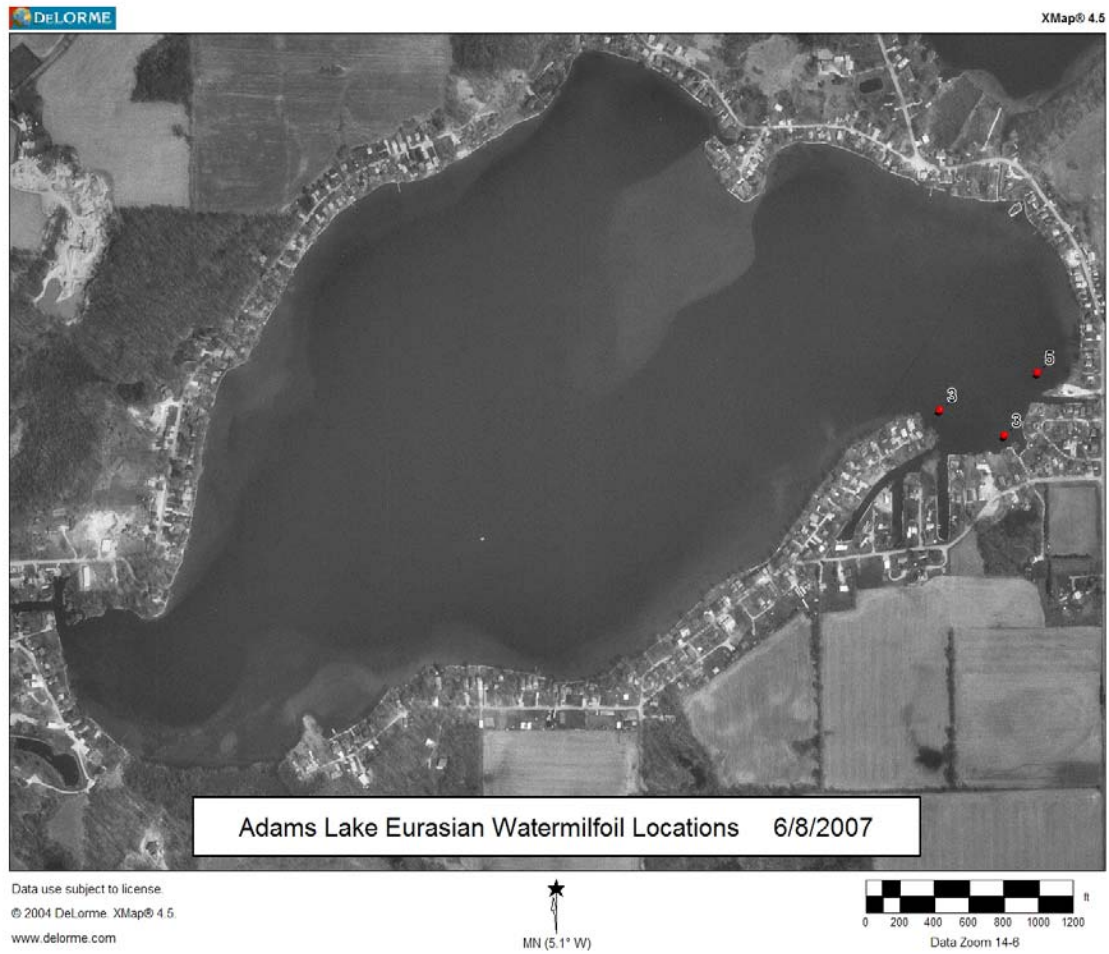


Figure 18: June 2007 Illinois Pondweed Locations

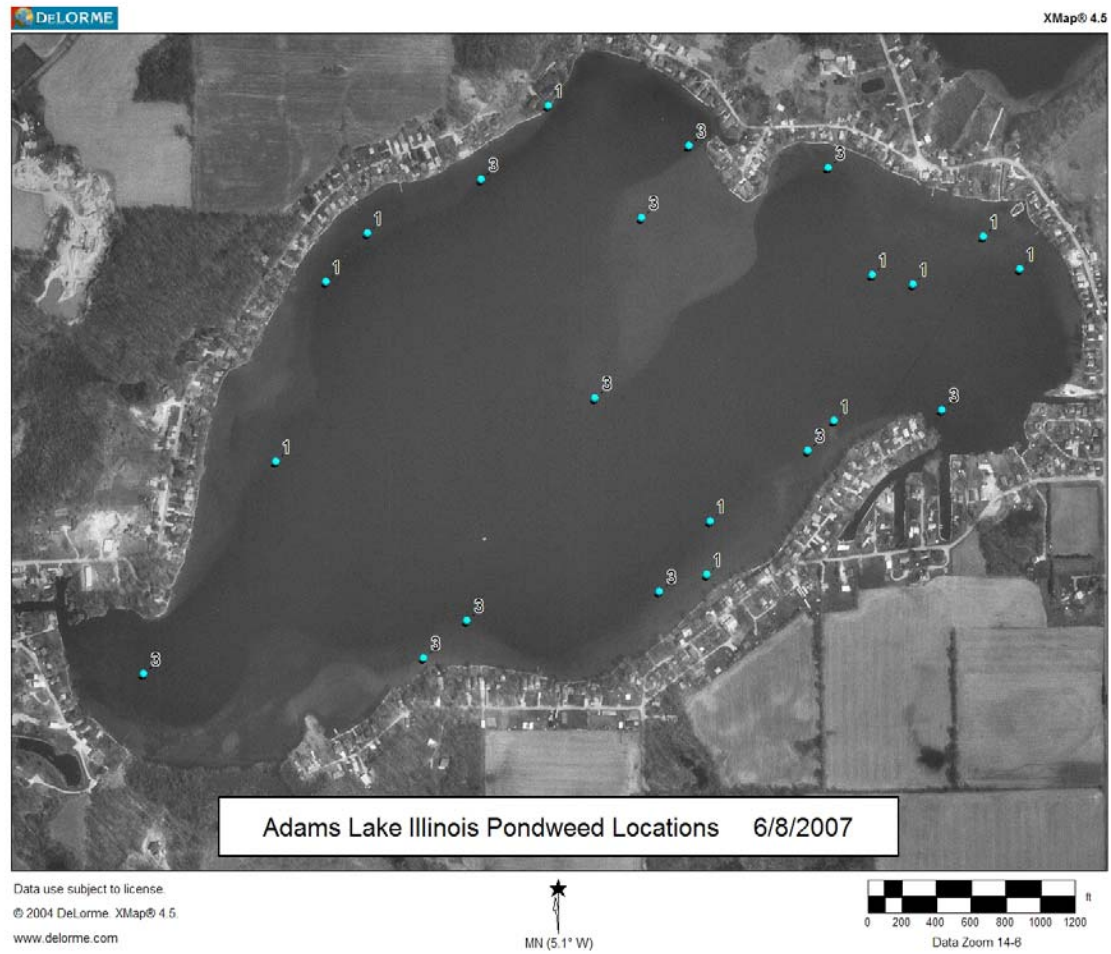


Figure 19: June 2007 Nitella Locations



Figure 20: June 2007 Richardson's Pondweed Locations

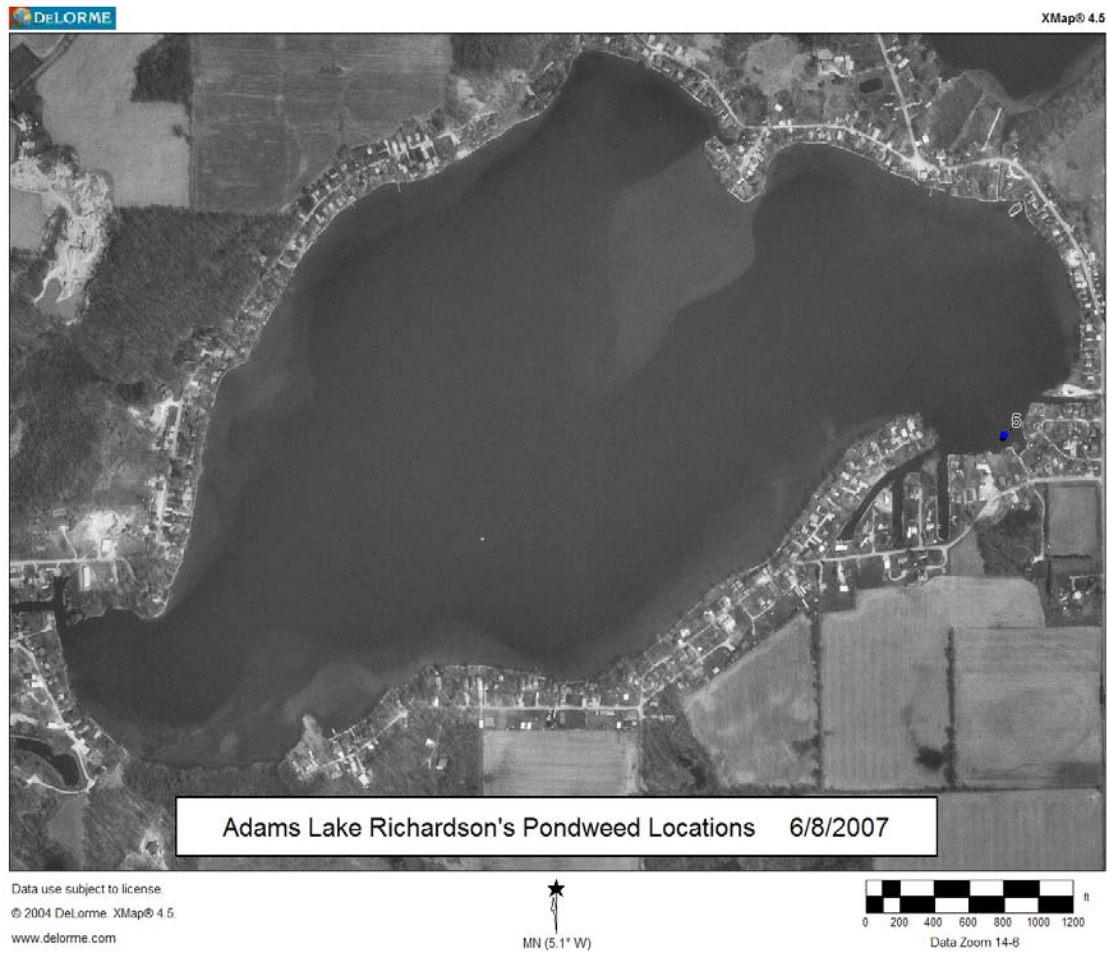


Figure 21: June 2007 Sago Pondweed Locations

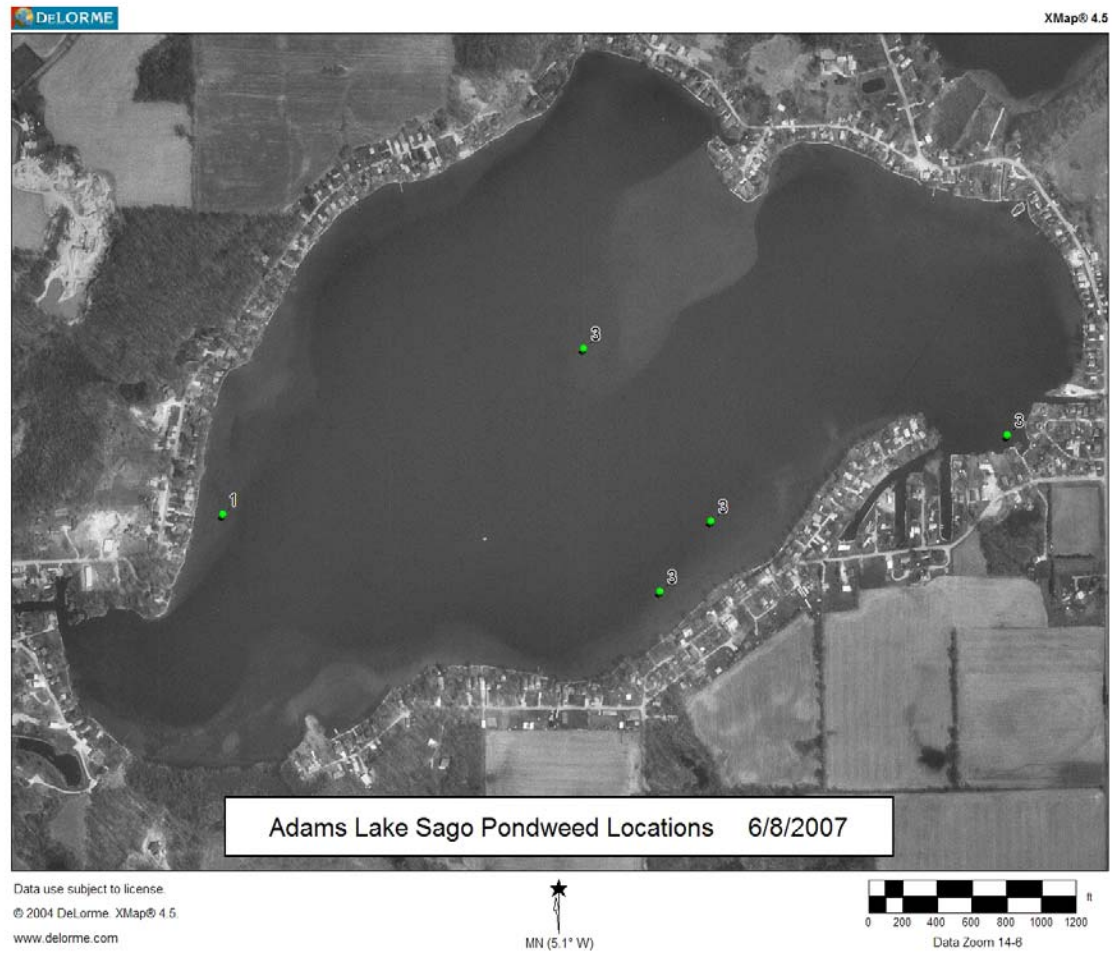
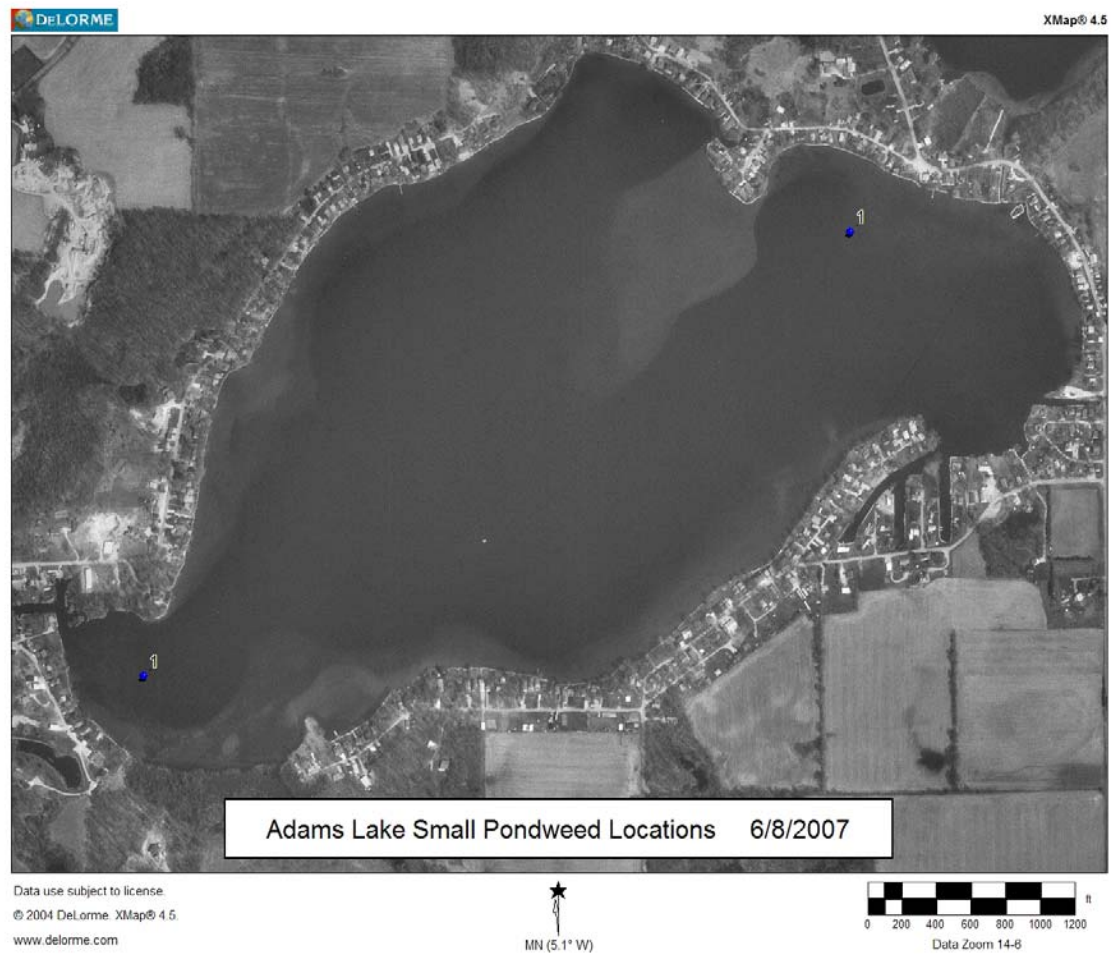


Figure 22: June 2007 Small Pondweed Locations



August 2007

Figure 23: July 2007 Bladderwort Locations

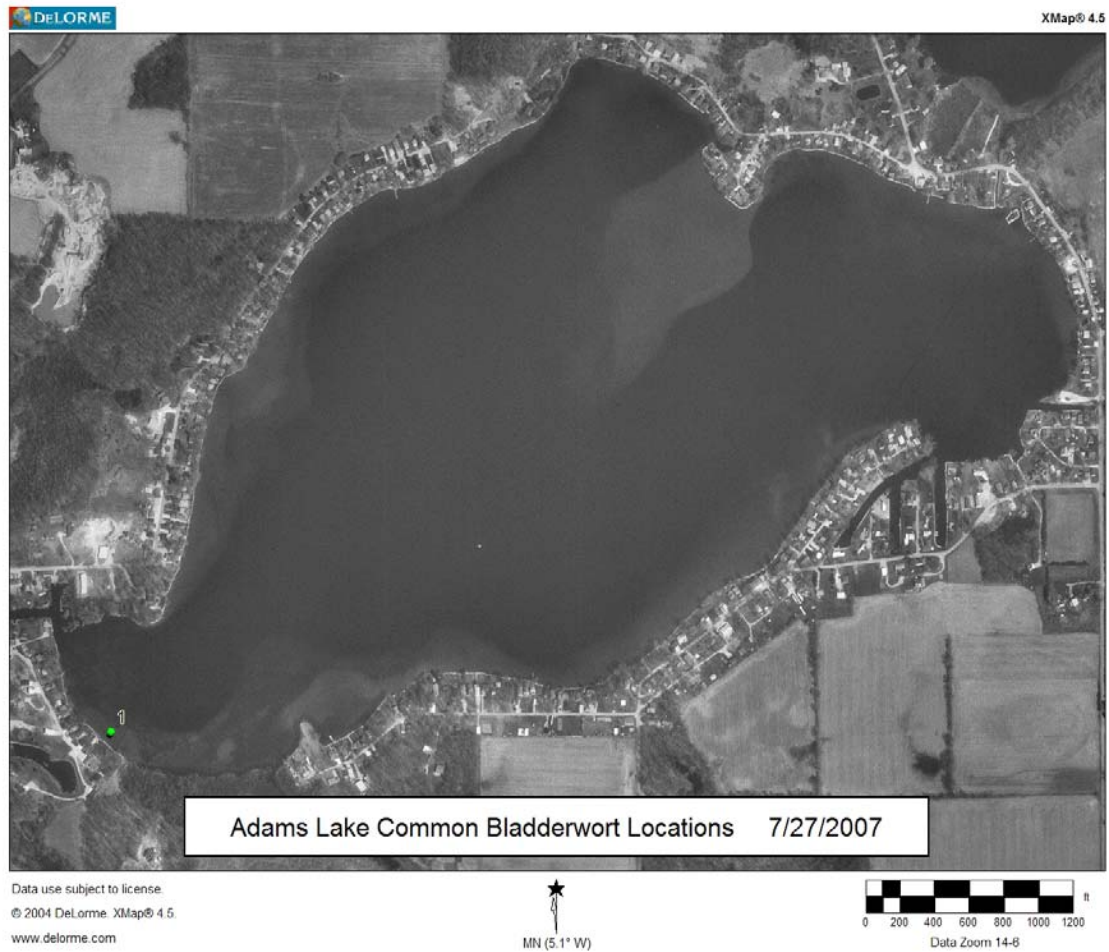


Figure 24: July 2007 Brittle Naiad Locations

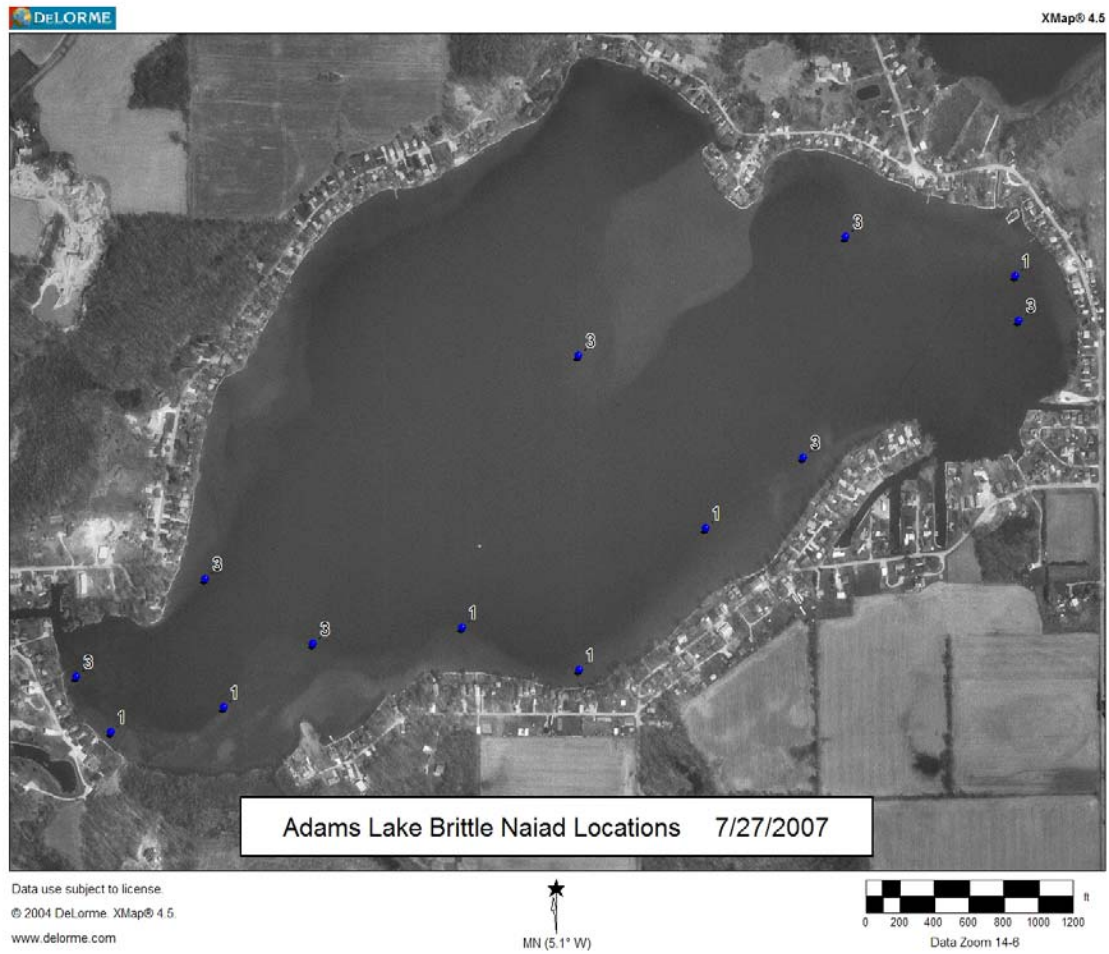


Figure 25: July 2007 Chara Locations

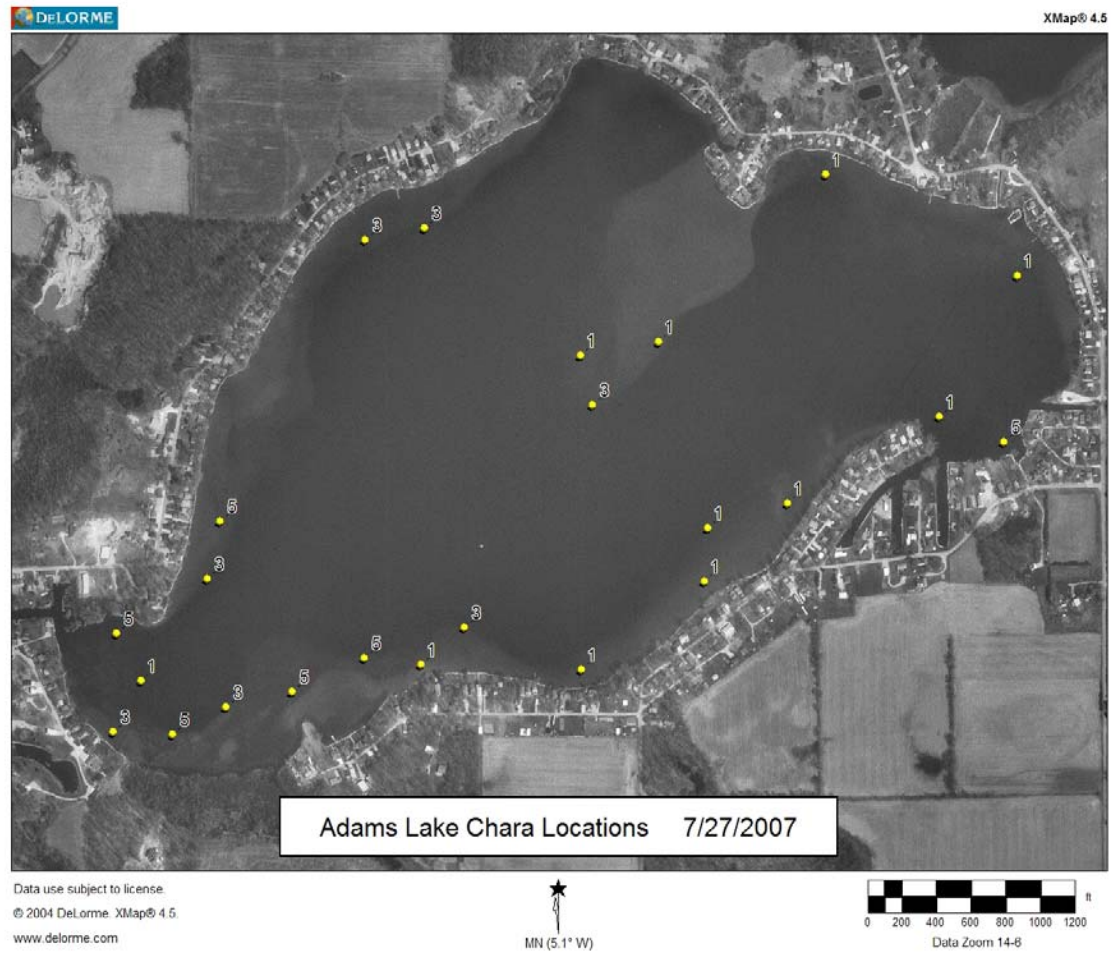


Figure 26: July 2007 Coontail Locations

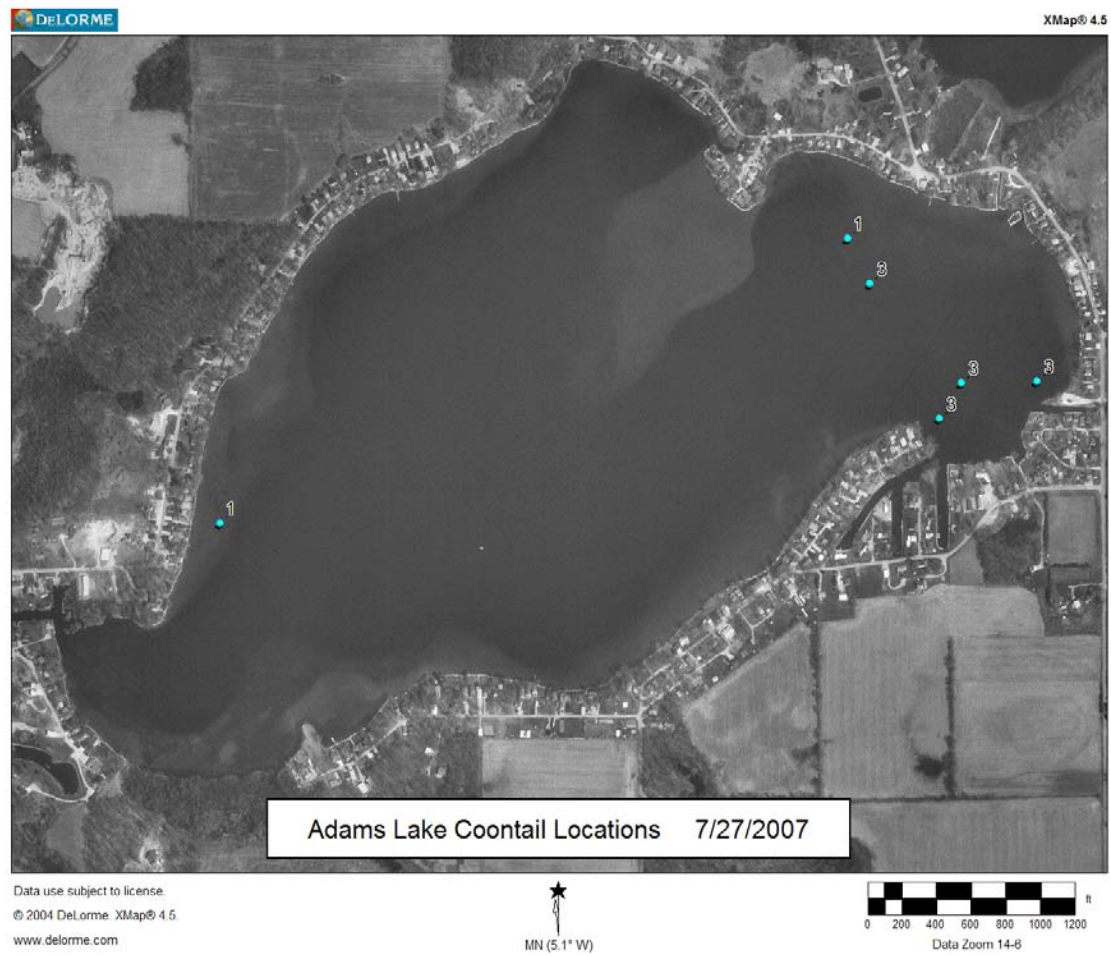


Figure 27: July 2007 Curly Leaf Pondweed Locations

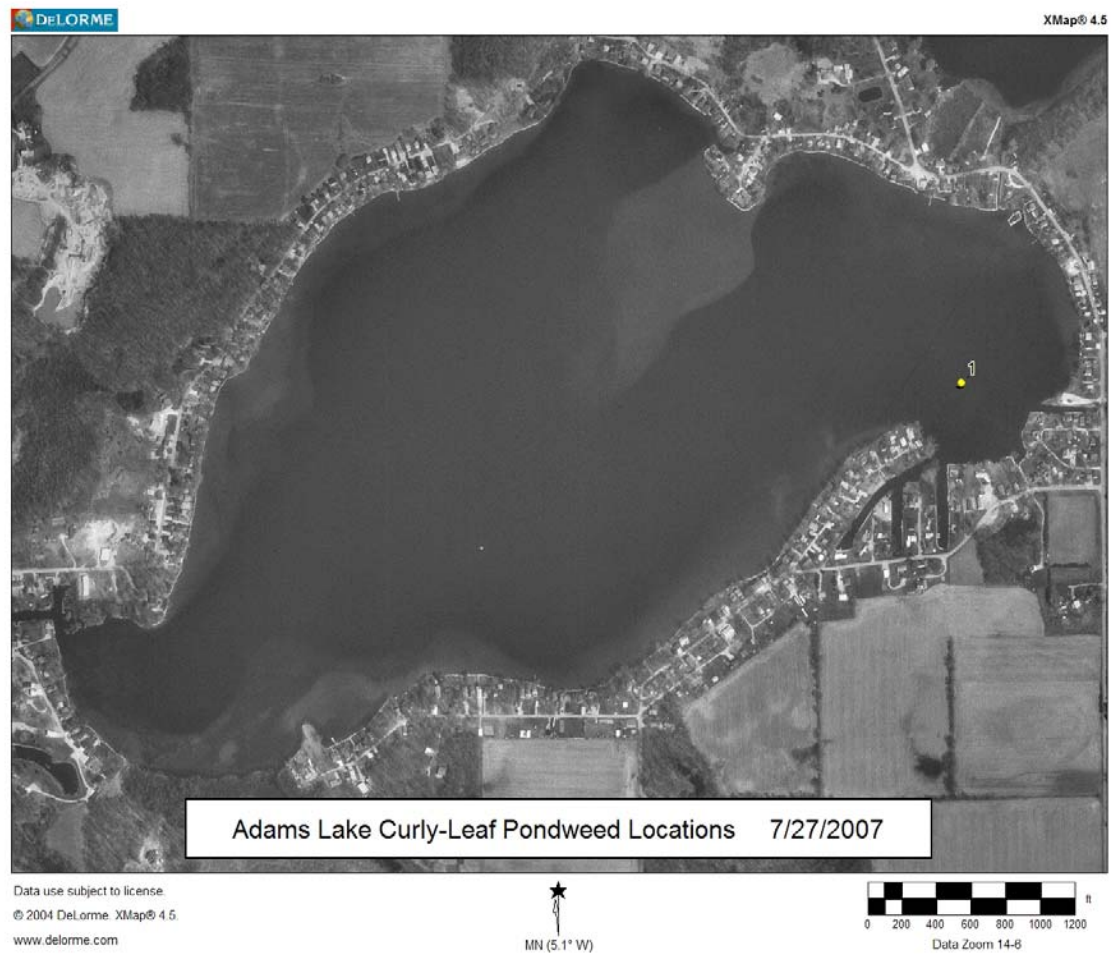


Figure 28: July 2007 Elodea Locations



Figure 29: July 2007 Flat-Stemmed Pondweed Locations

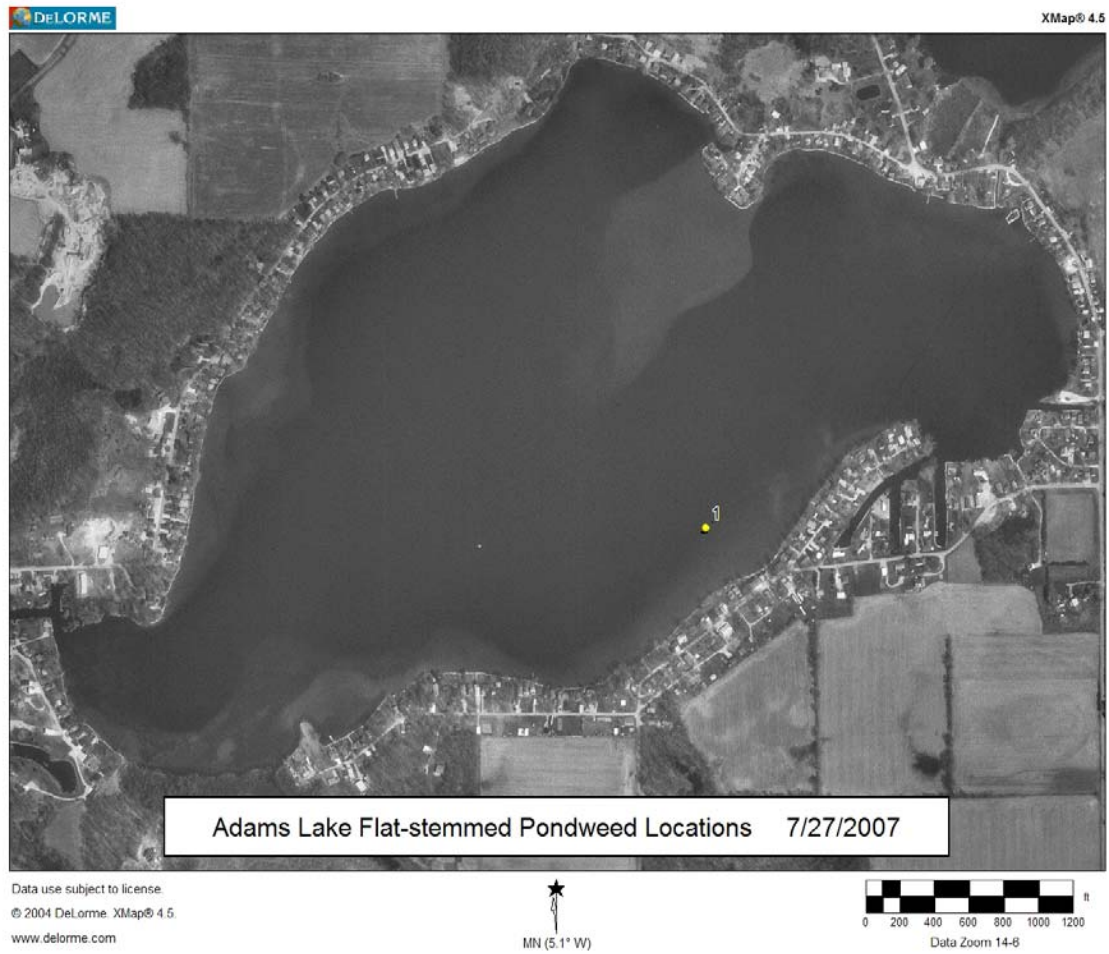


Figure 30: July 2007 Illinois Pondweed Locations

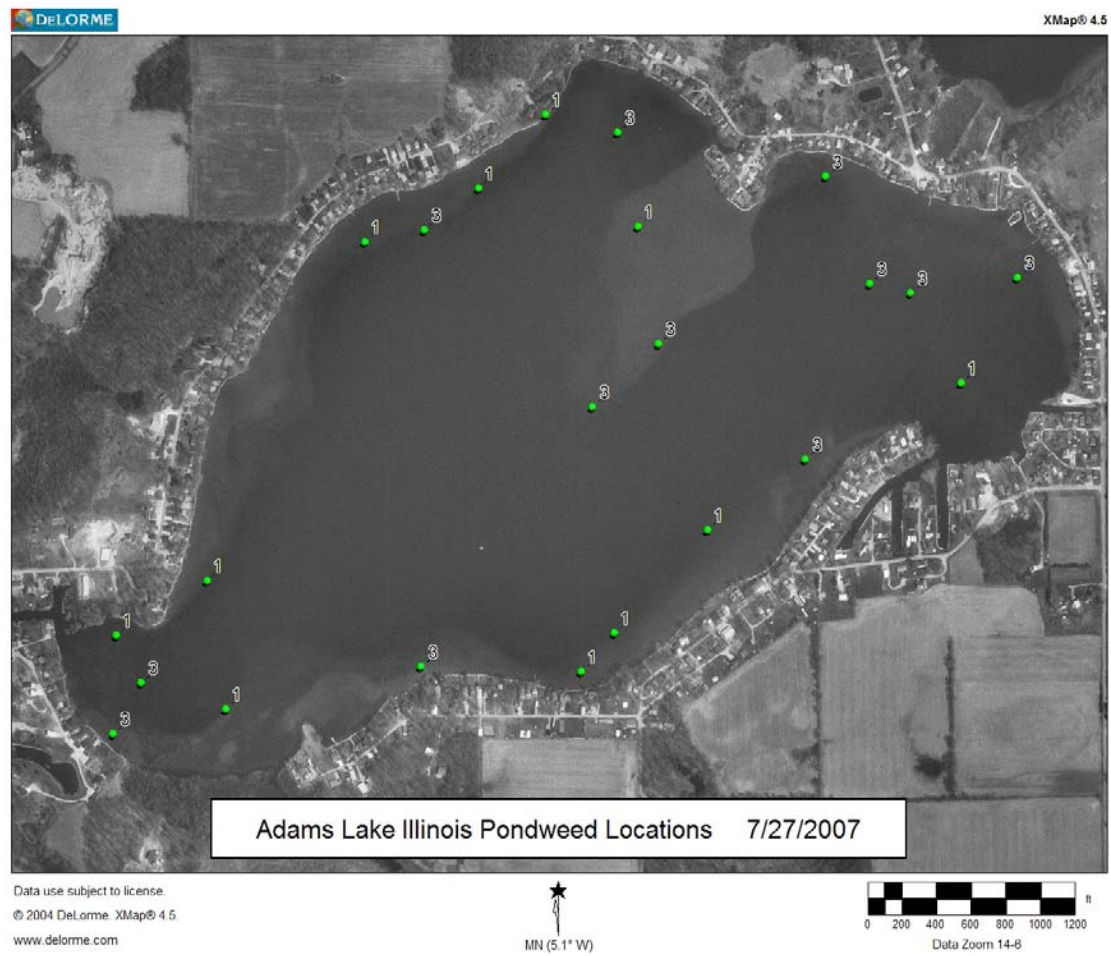


Figure 31: July 2007 Nitella Locations

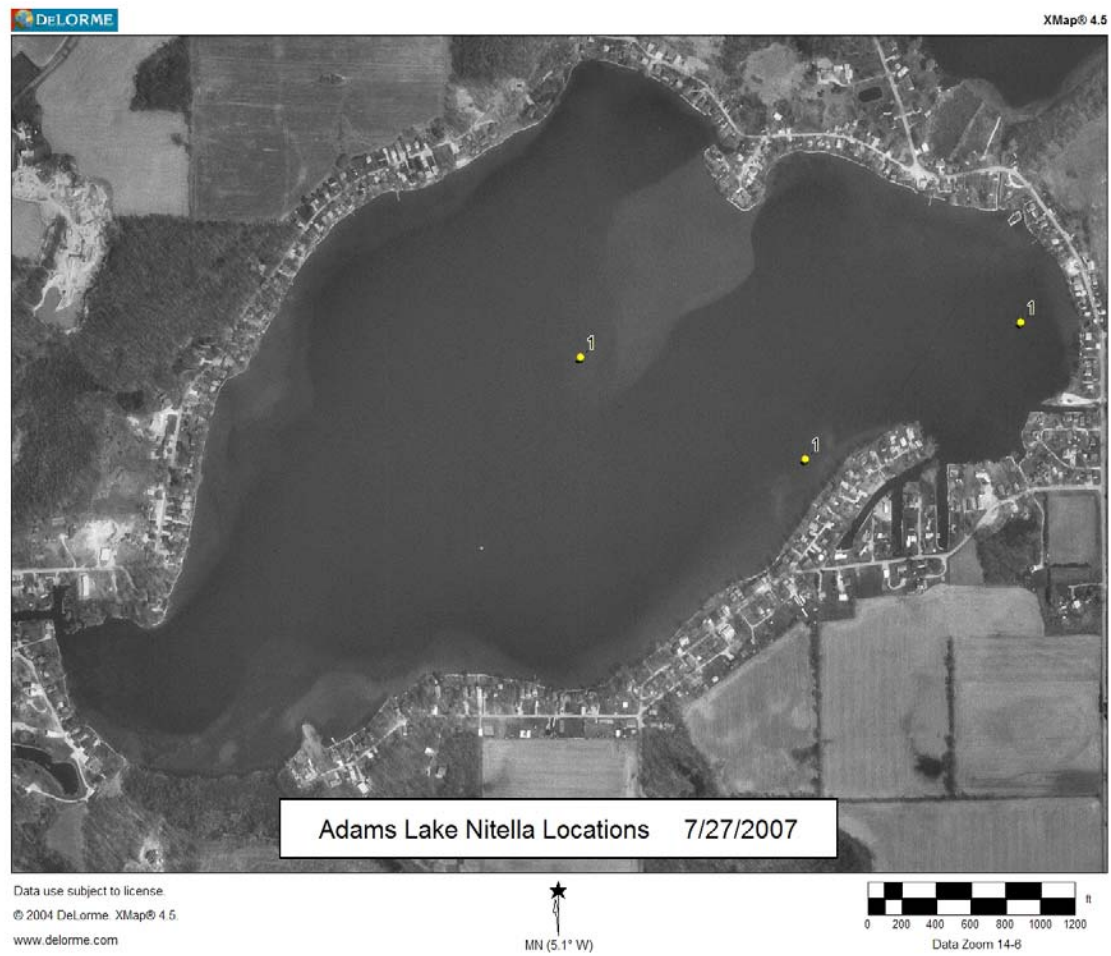


Figure 32: July 2007 Richardson's Pondweed Locations

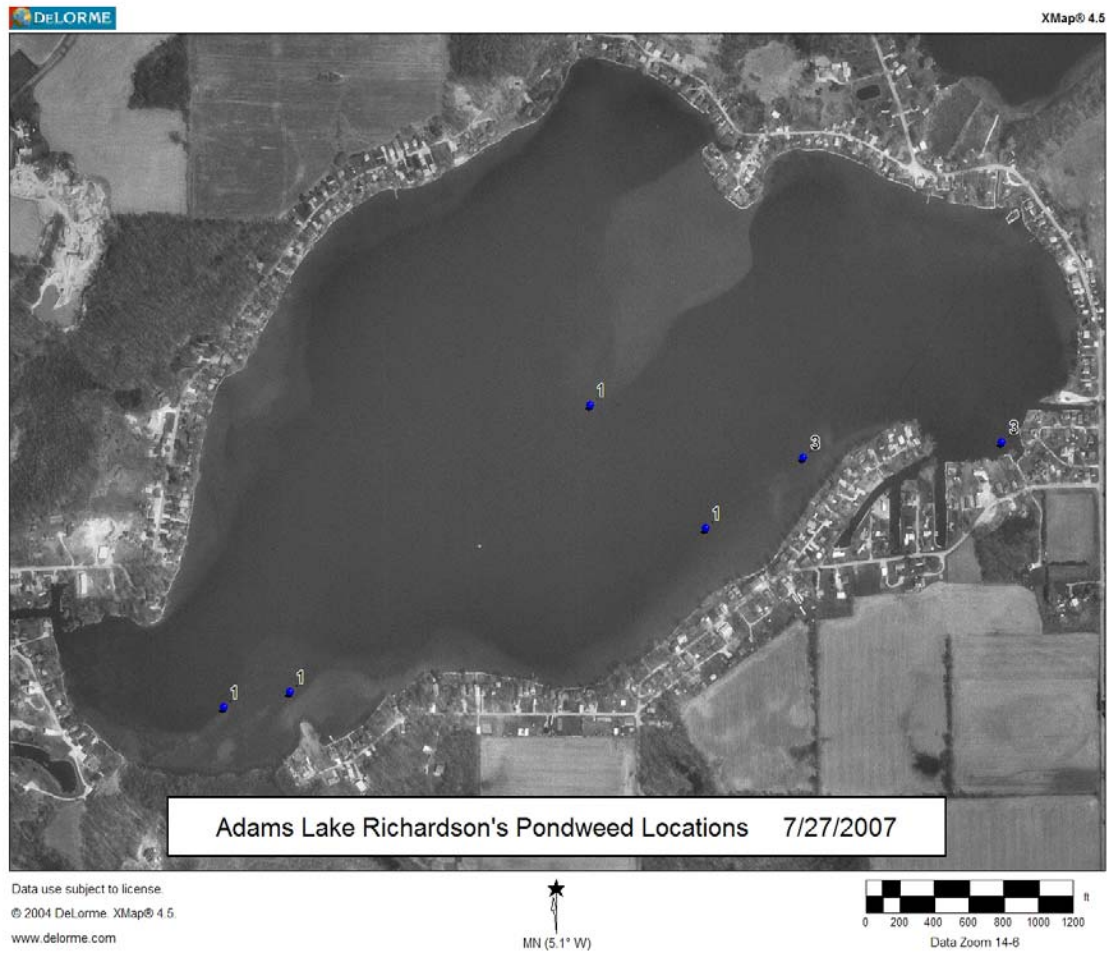


Figure 33: July 2007 Sago Pondweed Locations

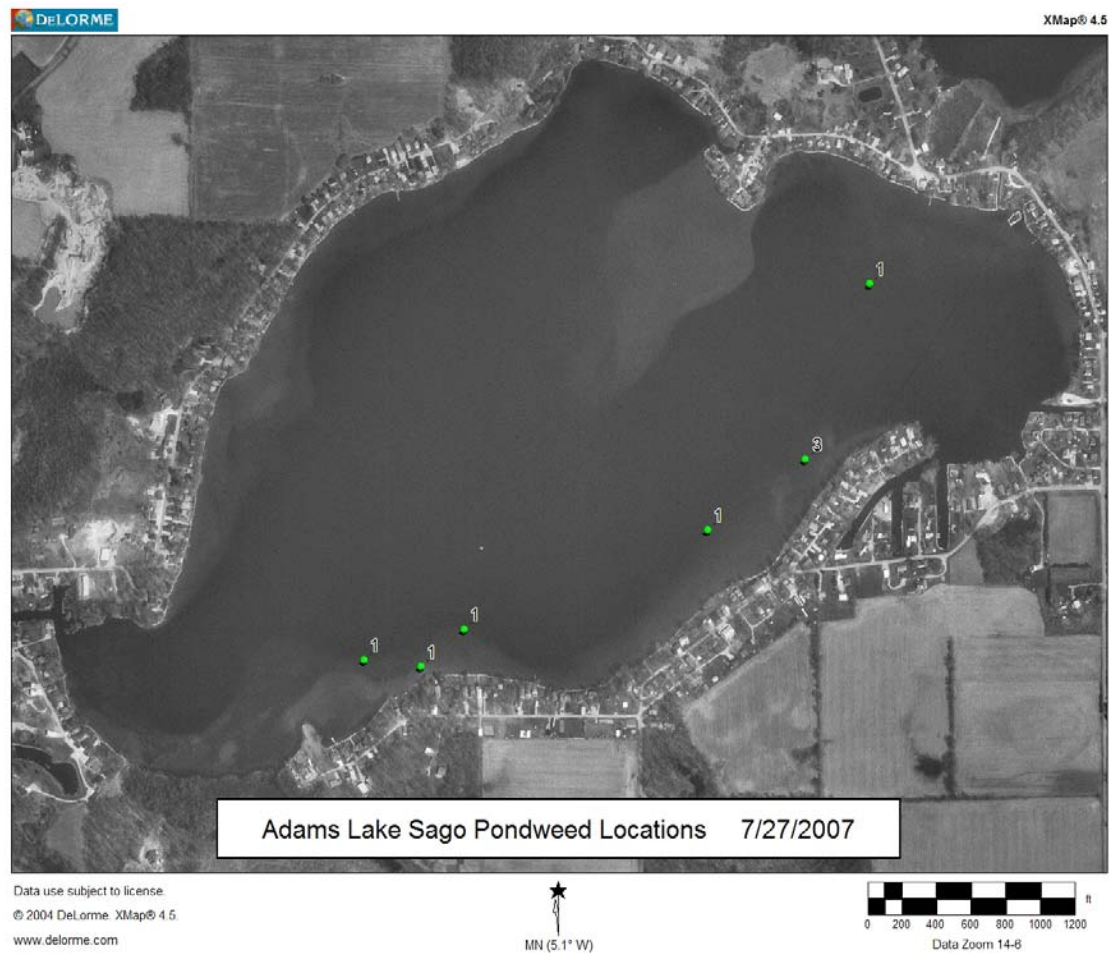


Figure 34: July 2007 Slender Naiad Locations

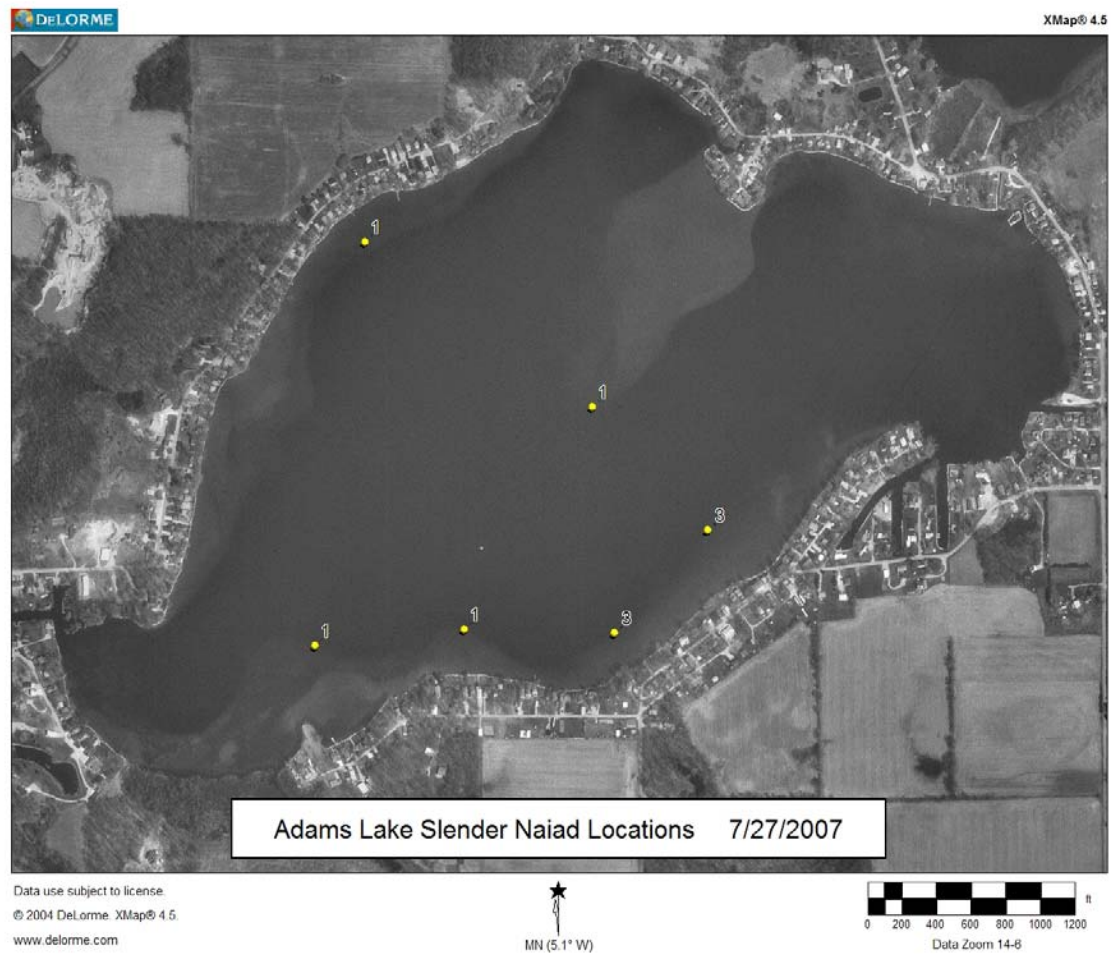


Figure 35: July 2007 Small Pondweed Locations



16.8 Data Sheets

Aquatic Vegetation Random Sampling (Tier 2)

Waterbody Cover Sheet

Surveying Organization:

Aquatic Weed Control

Contact Information:

574-533-2597

Waterbody Name:

Adams Lake

Lake ID:

Adams

County(s):

La Grange

Date:

6-8-07

Habitat Stratum:

I L

Avg. Lake
Depth (ft):

25

Lake Level:

Avg.

GPS Metadata

Crew

Leader:

Dave Keister

Datum:

Zone:

Accuracy:

NAD83

16

30 ft

Recorder:

Dave Keister

Method:

WAAS enabled GPS

Secchi Depth (ft):

8 1/2 ft

Total # of Points
Surveyed:

60

Total # of
Species:

11

Littoral Zone Size (acres):



Measured

106



Estimated

Littoral Zone Max. Depth (ft):



Measured

12 ft



Estimate (historical Secchi)



Estimated (current Secchi)

maximum plant depth

Notable Conditions:

Heavy milfoil beds in east end
by public access; good water
quality and dissolved oxygen

Submersed Aquatic Vegetation Survey (Tier II) Datasheet

Page 1 of 3

WATERBODY NAME: Adams Lake					DATE: June 8, 2007				
COUNTY: Lagrange County					SECCHI DEPTH (FT): 8 1/2 feet				
SITE ID: Adams					MAX PLANT DEPTH (FT): ~12 feet				
SURVEYING ORGANIZATION: Aquatic Weed Control					WEATHER: Windy, partly cloudy				
CREW LEADER: David Keister					COMMENTS (Include voucher codes - V1, V2...): H ₂ O 74				
RECORDER: David Keister					22 0-5 20 5-10 18 10-15				
CONTACT INFO: 574-533-2597					Rake score (1, 3, 5). 9 = algae, emergent or species observed but not sampled.				

Point #	R/T	Latitude	Longitude	Depth	Species Codes:								V1 Notes	
					milfoil	coon	curly	clara	elodea	potl	Sag	Small		
1	R	GPS Points		4	5	3	3		3				3	P
2				8										
3				13										
4	↓			3				3						
5	↓			8							1			
6				11						1				
7				4				3		3				
8				6				1						
9				13										
10				3				3						
11				7				3		3				
12				12										
13				3				3		3				
14				8		3				3				
15				14										
16				4				1		1				
17				3				1						
18				7						3				
19				11				3						
20				4				3		1				
21				8				3		1				
22				12										
23				2										
24				8				3		1				
25			0-5	5				3			1			
26				9										
27				13										
28				2				5						
29				7				3		3		1		
30				3		1		1						
31				3										
32				7				5						

Other plant species observed at lake:

Submersed Aquatic Vegetation Survey (Tier II) Datasheet

Page 2 of 2

WATERBODY NAME: <u>Adams Lake</u>					DATE: <u>June 8, 2007</u>				
COUNTY: <u>Lagrange</u>					SECCHI DEPTH (FT): <u>4 1/2 ft</u>				
SITE ID: <u>Adams</u>					MAX PLANT DEPTH (FT):				
SURVEYING ORGANIZATION: <u>Aquatic Weed Control</u>					WEATHER: <u>windy / partly cloudy</u> water Temp				
CREW LEADER: <u>David Keister</u>					COMMENTS (include voucher codes - V1, V2...): <u>74°</u>				
RECORDER: <u>David Keister</u>					<u>22 0-5 20 5-10 18 10-15</u>				
CONTACT INFO: <u>74-533-2597</u>					Rake score (1, 3, 5). 9 = algae, emergent or species observed but not sampled.				

Point #	R/T	Latitude	Longitude	Depth	Species Codes:										eel	Notes
					milf	codn	Curly	Chen	elo	Pail	Sage	Smud				
33	R			11												
34				2					5							P
35				9	-											
36			0-5	5					3							
37				3					3		3					
38				9					3		3					
39				12	-											
40				4					3							
41				7					1							
42				12					1		3	3				
43				3					1		1					
44				9					1		1	3				
45				12	-											
46				3					3							
47				5							3				1	
48				8							1					
49				13	-											
50				5	3	3	3	3			3					P
51				3	3	1	3					3				mt-1 20-15
52				9		5										
53				6							1					
54				15	-											
55				7	-											
56				14	-											
57				15	-											
58				14	-											
59				8								3				
60				14	-											

Other plant species observed at lake:

Submersed Aquatic Vegetation Survey (Tier II) Datasheet

Page 3 of 3

WATERBODY NAME: <u>Adams Lake</u>					DATE: <u>June 8, 2007</u>					
COUNTY:					SECCHI DEPTH (FT):					
SITE ID:					MAX PLANT DEPTH (FT):					
SURVEYING ORGANIZATION:					WEATHER:					
CREW LEADER:					COMMENTS (Include voucher codes - V1, V2...):					
RECORDER:										
CONTACT INFO:					Rake score (1, 3, 5). 9 = algae, emergent or species observed but not sampled.					
Point #	R/T	Latitude	Longitude	Depth	Species Codes:					Notes
		Surface	8.04	73.2						
		1.5	8.05	73.1						
		3	8.07	73.0						
		4.5	8.07	73.0						
		6	8.06	72.9						
		7.5	8.07	72.9						
		9	8.05	72.9						
		10.5	8.06	72.9						
		12	8.08	72.8						
		13.5	8.08	72.8						
		15	8.07	72.7						
		16.5	8.08	72.7						
		18	8.05	72.1						
		19.5	7.57	62.4						
		21	7.43	61.0						
		22.5	6.77	56.0						
		24	6.31	56.8						
		25.5	5.26	52.5						
		27	5.25	51.8						
		28.5	4.94	50.2						
		30	4.71	49.0						
		31.5	4.67	48.1						
		33	4.50	47.5						
		34.5	4.01	47.1						
		36	3.91	46.5						
		37.5	4.04	45.7						
		39	4.33	45.1						
		40.5	4.08	45.5						
Other plant species observed at lake:										

DO/Temp
Profile

Aquatic Vegetation Random Sampling (Tier 2)

Waterbody Cover Sheet

Surveying Organization:

Aquatic Weed Control

Contact Information:

574 - 533 - 2597

Waterbody Name:

Adams Lake

Lake ID:

Adams

County(s):

LaGrange

Date:

July 27, 2007

Habitat Stratum:

IL

Avg. Lake Depth (ft):

25

Lake Level:

Aug

GPS Metadata

Crew

Leader:

Dave Keister

Datum:

Zone:

Accuracy:

NAD83

16

30ft

Recorder:

Dave Keister

Method:

WAAS Enabled GPS

Secchi Depth (ft):

8.1

Total # of Points
Surveyed:

60

Total # of
Species:

11

Littoral Zone Size (acres):



Measured

106



Estimated

Littoral Zone Max. Depth (ft):



Measured

12



Estimate (historical Secchi)



Estimated (current Secchi)

max
plant
Depth

Notable Conditions:

milfoil beds no longer present at public access
water temp 76.6 at surface
good Dissolved oxygen to 18 feet

Submersed Aquatic Vegetation Survey (Tier II) Datasheet

Page 1 of 3

WATERBODY NAME: Adams Lake					DATE: July 27 2007											
COUNTY: Labarge					SECCHI DEPTH (FT): 8.1											
SITE ID: Adams					MAX PLANT DEPTH (FT): 11 feet											
SURVEYING ORGANIZATION: Aquatic Weed Control					WEATHER: Hot, Sunny, Breezy											
CREW LEADER: Dave Keister					COMMENTS (Include voucher codes - V1, V2...):											
RECORDER: Dave Keister					Water Temp 76.6											
CONTACT INFO: 574-533-2597					Rake score (1, 3, 5). 9 = algae, emergent or species observed but not sampled.											
Point #	R/T	Latitude	Longitude	Depth	Species Codes:								Algae Notes			
					Chara	Potil	Kelam	Najas	Nitell	Stuck	PotP	NATIE				
→	R	Waypoints		1	4			3								
				2	8				3	1						
				3	13	-										
				4	3	-										
				5	8		3									
				6	11		3	3			1	1				
				7	4	1	3									
				8	6	-										
				9	13	-										
				10	3	1	3									
				11	7	3	3									Rich-1
				12	12	-										
				13	3		1									P
				14	8	-										
				15	14		3									
				16	4		1									
				17	3	-										
				18	7		1									
				19	11	3	3									
				20	4	3	1									
				21	8	-										
				22	12	-										
				23	2	-										
				24	8	-										
		V2-1		25	5	5		1								
		V5-1		26	9	3	1		3							
				27	13	-										
				28	2	5	1									
				29	7	1	3									
				30	3				3							
				31	3	3	3		1							8/edder-1
				32	7	5										
				33	11	3	1		1							Rich-1
Other plant species observed at lake:																

Submersed Aquatic Vegetation Survey (Tier II) Datasheet

Page 2 of 3

WATERBODY NAME: <u>Adams Lake</u>					DATE: <u>July 27, 2007</u>												
COUNTY: <u>Lagrange</u>					SECCHI DEPTH (FT): <u>8.1 ft</u>												
SITE ID: <u>Adams</u>					MAX PLANT DEPTH (FT): <u>11 feet</u>												
SURVEYING ORGANIZATION: <u>Aquatic Weed Control</u>					WEATHER: <u>Hot Sunny Breezy</u>												
CREW LEADER: <u>Dave Keister</u>					COMMENTS (Include voucher codes - V1, V2...):												
RECORDER: <u>Dave Keister</u>																	
CONTACT INFO: <u>574-533-2597</u>					Rake score (1, 3, 5). 9 = algae, emergent or species observed but not sampled.												
Point #	R/T	Latitude	Longitude	Depth	Species Codes:										Notes		
					Chara	POTILL	Ceratan	Najas	NETELL	STURGE	NASFL	Elocan					
→	R	Watkins	34	2	5												
			35	9					3				1				Rich-1
			36	5	5							1					
			37	3	1	3						1					
			38	9	3	7			1			1	1				
			39	12	-												
			40	4	1	1			1								
			41	7	-	1							3				
			42	12	-												
			43	3	1												
			44	9	1	1			1			1	3				Rich-1 Flop
			45	12	-												
			46	3	1												
			47	5		3			3	1	3						Rich-3
			48	8	-												
			49	13	-												
			50	5	1			3									Rich-3
			51	3	5								1				CL-1
			52	9			1	3									
			53	6	1	3			1								
			54	15	-												
			55	7				1	3								
			56	14	-												
			57	15	-												
			58	14	-												
			59	8	1				3	1							
			60	14	-												
Other plant species observed at lake:																	

Submersed Aquatic Vegetation Survey (Tier II) Datasheet

Page 3 of 3

Page 1 of 1

WATERBODY NAME: Adams Lake					DATE: July 27, 2007											
COUNTY: Lagrange					SECCHI DEPTH (FT): 8.1' ft											
SITE ID: Adams					MAX PLANT DEPTH (FT): 11											
SURVEYING ORGANIZATION: Aquatic Weed Control					WEATHER: Hot Sunny Breezy											
CREW LEADER: Dave Keister					COMMENTS (Include voucher codes - V1, V2...):											
RECORDER: Dave Keister																
CONTACT INFO:					Rake score (1, 3, 5). 9 = algae, emergent or species observed but not sampled.											
Point #	R/T	Latitude	Longitude	Depth	Species Codes:										Notes	
					Do	Tcmf										
			Surface		8.85	76.6										
			1.5		8.85	76.6										
			3		8.85	76.6										
			4.5		8.83	76.5										
			6		8.80	76.4										
			7.5		8.77	76.4										
			9		8.75	76.4										
			10.5		8.71	76.3										
			12		8.52	76.2										
			13.5		7.75	75.3										
			15		7.51	74.8										
			16.5		6.41	74.1										
			18		5.18	72.9										
			19.5		1.85	70.5										
			21		0.15	67.5										
			22.5		0.09	62.8										
			24		0.06	59.7										
			25.5		0.05	58.0										
			27		0.04	55.0										
			28.5		0.03	53.3										
			30		0.03	52.0										
			31.5		0.02	50.8										
			33		0.02	49.9										
			34.5		0.02	49.1										
			36		0.02	48.7										
			37.5		0.02	47.9										
			39		0.02	47.4										
			40.5		0.02	46.9										
Other plant species observed at lake:																

Sample Location GPS Coordinates

Latitude	Longitude	site
41.554617	-85.319849	1
41.555555	-85.32018	2
41.555893	-85.321319	3
41.556767	-85.321036	4
41.556024	-85.322524	5
41.556169	-85.323383	6
41.557855	-85.324306	7
41.55723	-85.325652	8
41.556179	-85.326014	9
41.55522	-85.327845	10
41.554226	-85.329254	11
41.555974	-85.329549	12
41.557063	-85.32827	13
41.558215	-85.327252	14
41.558557	-85.328717	15
41.558844	-85.330243	16
41.558207	-85.331117	17
41.55767	-85.331661	18
41.557018	-85.332803	19
41.556822	-85.334067	20
41.556066	-85.334931	21
41.554954	-85.335235	22
41.554505	-85.336411	23
41.553208	-85.33599	24
41.552374	-85.337128	25
41.551466	-85.337406	26
41.550741	-85.338287	27
41.550607	-85.339325	28
41.549853	-85.338791	29
41.549924	-85.340135	30
41.549049	-85.339385	31
41.549004	-85.338126	32
41.54944	-85.336995	33
41.549675	-85.335595	34
41.550445	-85.335111	35
41.550222	-85.334079	36
41.550105	-85.332875	37
41.550695	-85.331967	38
41.550266	-85.330703	39
41.550029	-85.329482	40
41.550641	-85.328789	41
41.551159	-85.327882	42
41.551422	-85.326876	43
41.552268	-85.32681	44
41.55285	-85.326254	45
41.552665	-85.325125	46
41.553391	-85.324742	47
41.553858	-85.324191	48
41.554071	-85.322913	49
41.554028	-85.321906	50

41.553625	-85.320549	51
41.554593	-85.321436	52
41.55626	-85.320257	53
41.555817	-85.32199	54
41.55688	-85.323841	55
41.556655	-85.325704	56
41.555717	-85.326808	57
41.554587	-85.328318	58
41.555004	-85.329494	59
41.555602	-85.329259	60

16.9 IDNR Aquatic Vegetation Control Permit

To be included in the final report.

